Department of Industrial Engineering and Management

Co-Creating Health

Examining the Effects of Co-Creation in a Lifestyle Intervention Service Targeting Physical Activity

Karita Reijonsaari

Aalto University

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Karita Reijonsaari

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Abstract

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Abstract

Health behavior is an important determinant of an individual's health. The increase in chronic diseases in developed countries has been, to a large extent, caused by unhealthy, e.g., sedentary lifestyles. The results are unnecessary suffering and substantial cost to society. Lifestyle interventions as a service seek to co-create improved health behavior with individuals. The objective of using them is to prevent or manage chronic illness. Employers are gradually becoming more interested in investing in the health of their employees and are hoping to capture value from these investments. In this context, value refers to improved health and increased capability. As employers seek these goals, lifestyle interventions are being increasingly implemented in an occupational setting. However, there is limited evidence concerning their effectiveness.

This research examines the effects of co-creation in lifestyle interventions targeting physical activity in an occupational setting. Co-creation of value in a service relationship has been widely discussed by service research, particularly in the domain of Service-dominant logic. Co-creation in the context of health, on the other hand, has received limited attention. This dissertation contributes to the discourse on Service-dominant logic and co-creation of health. It extends conceptual models on co-creation to account for the particular characteristics of a lifestyle intervention service context, as well as the role of an employer as a third party in co-creation.

The empirical research was conducted as a randomized controlled trial examining the effects of co-creation in a physical activity intervention. The lifestyle intervention that was examined was found to be ineffective in changing health behavior: no effects of co-creation on physical activity were observed, nor were work-related outcomes of increased productivity or reduced sickness absence seen. This suggests that these types of interventions may not be as effective as popularly believed. This study demonstrates that although interaction takes place in a service relationship, value is not always co-created, and improved health and increased capability may not occur. Thus, co-creation is interaction, but not all interaction is co-creation. The results of this study highlight the idea that employer investments in lifestyle interventions should be based on evidence of their effectiveness in the specific context.

Keywords Co-creation, lifestyle, physical activity intervention, service, health outcome, capability, interaction, RCT, effectiveness

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Tiivistelmä

Terveyskäyttäytyminen on tärkeä yksilön terveyttä määrittävä tekijä. Kroonisten sairauksien yleistyminen aiheutuu suurilta osin epäterveellisistä elämäntavoista kuten vähäisestä liikunnasta. Nämä valinnat synnyttävät paitsi sairauksia myös merkittäviä kustannuksia yhteiskunnalle. Elämäntapainterventiot pyrkivät tukemaan yksilöä paremman terveyden saavuttamisessa. Nämä palvelut tähtäävät kroonisten sairauksien ennaltaehkäisyyn tai hallintaan. Elämäntapainterventiot ovat yleistymässä työpaikoilla, monia niistä käytetään kuitenkin ilman riittävää näyttöä vaikuttavuudesta. Työnantajat ovat kiinnostuneita investoimaan työntekijöiden terveyteen ja toivovat täten saavuttavansa myös liiketoiminnallista arvoa. Arvo, tässä kontekstissa, viittaa työntekijän parantuneeseen terveyteen ja työkykyyn, joihin panostamalla työnantajat tavoittelevat tuottavuuden kasvua. Tässä tutkimuksessa tarkasteltiin arvon yhteisluonnin vaikutuksia työpaikan elämäntapainterventiossa, joka tähtäsi liikunta-aktiivisuuden lisäämiseen.

Arvon yhteisluonnista palveluissa on keskusteltu laajasti palvelututkimuksessa, erityisesti Service-dominant logic kirjallisuudessa. Arvon yhteisluonti terveyskontekstissa on kuitenkin jäänyt vähemmälle huomiolle. Tämä väitöskirja edistää Service-dominant logic tutkimusta arvon yhteisluonnista terveyskontekstissa. Tutkimuksessa laajennetaan aikaisempia konseptuaalisia malleja arvon yhteisluonnista. Laajennetuissa malleissa huomioidaan elämäntapainterventioiden erityispiirteet sekä työnantaja kolmantena osapuolena arvon yhteisluonnissa.

Empiirisessä tutkimuksessa tarkasteltiin arvon yhteisluonnin vaikutuksia liikunta-aktiivisuusinterventiossa. Tutkimus toteutettiin satunnaistettuna vertailevana tutkimuksena. Tutkitulla palvelulla ei ollut vaikutusta terveyskäyttäytymiseen. Muutosta liikunta-aktiivisuudessa, työn tuottavuudessa tai sairauspoissaoloissa ei havaittu. Tämä viittaa siihen, etteivät tämän kaltaiset palvelut välttämättä ole niin vaikuttavia kuin yleisesti uskotaan. Tutkimuksessa osoitetaan, että vaikka palvelusuhteen aikana tapahtuu vuorovaikutusta, arvoa ei aina pystytä luomaan eikä parempaa terveyttä ja kyvykkyyttä välttämättä saavuteta. Arvon yhteisluonti tapahtuu vuorovaikutuksessa, mutta kaikki vuorovaikutus ei ole arvon yhteisluontia. Tutkimuksen tuloksissa korostuu, että investointien elämäntapainterventioihin tulisi perustua näyttöön niiden vaikuttavuudesta kyseisessä kontekstissa.

Avainsanat Arvon yhteisluonti, elämäntapa, liikunta-aktiivisuusinterventio, palvelu, terveys, kyvykkyys, vuorovaikutus, RCT, vaikuttavuus

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Olen ikionnellinen ja kiitollinen teiltä
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DEFINITIONS OF CONCEPTS

Concept or abbreviation	Definition in this dissertation
Capability	An opportunity and ability to utilize resources effectively and to generate valuable outcomes
Customer	A primary end-user of service.
CoAct	Co-creating Activity. The name of the randomized controlled trial described in this dissertation.
Co-creation	Interactive creation of value between collaborators. Value is realized through integration of resources through activities and interactions.
Effectiveness	The extent to how well a treatment works in practice (Drummond et al. 2005).
Exercise	A form of leisure-time physical activity that is usually performed repeatedly over an extended period of time with a specific external objective (e.g., improved fitness, physical performance, or health)
Health	A state of complete physical, mental and social well-being – not merely the absence of disease and infirmity (WHO 1984).
Health outcome	A change in the health status of an individual, group or population that is attributable to a planned intervention or series of interventions, regardless of whether changing health status was the intent.
Interaction	Mutual or reciprocal interaction and activities where two or more parties have an effect upon one another.

Lifestyle intervention	An effort to promote behavior that is beneficial for health or to prevent behavior detrimental for health. Lifestyle interventions may be run by a variety of organizations, including healthcare providers and private companies.
Motivation	The process that initiates, guides and maintains goal-oriented behaviors.
PA	**Physical activity.** Any bodily movement produced by skeletal muscles resulting in energy expenditure. PA can be categorized into occupational, sports, conditioning, household, or other activities. Exercise is a subset of physical activity.
Process	A set of interrelated tasks that together transform inputs into outputs.
RCT	**Randomized controlled trial.** A quantitative, comparative, controlled experiment used to examine an intervention's effect.
Relationship performance	The total value formed during interaction between service provider and customer over time (Storbacka & Nenonen 2009).
Resource integration	All economic actors are resource integrators and integrate goods, service and other resources to create value.
S-D logic	**Service-dominant Logic.** A mindset for a unified understanding of the purpose and nature of organizations, markets and society. See www.sdlogic.net.
Service	A change in the condition of one actor produced by the activity of another agent by the application of competencies (knowledge and skills) for the benefit of another (Vargo & Lusch 2004)
Service relationship	Longitudinal social and economic processes for the co-creation of value.
Value proposition	A service provider's invitation to a customer to participate in co-creating value that is superior to competitor offerings (Lusch & Webster 2010).

CHAPTER 1

INTRODUCTION

This chapter introduces co-creation of health as a phenomenon of interest. It begins with a presentation of the empirical problem and the context in which it is studied. This is followed by description of the theoretical approach adopted in this dissertation. Purpose of the dissertation is then presented and research questions formulated. The chapter ends with an assessment of the intended contribution and presentation of the structure of the dissertation.

"The only way to keep your health is to eat what you don't want, drink what you don't like, and do what you'd rather not." (Mark Twain)

The most important determinant of an individual's health is his or her own health behavior (McGinnis et al. 2002). Different types of service can support an individual in co-creating better health. Co-creation implies meaningful engagements of interaction, activities and exchange between collaborators. Achieving health often requires integrating resources beyond an individual's own. These resources can include highly specialized medical knowledge, medication, surgical operations or health behavior change support. They may be beyond an individual's personal skills or current resources.

Health has been recognized as a *co-created* outcome in the service literature (Bitner et al. 1997; McColl-Kennedy et al. 2009). This dissertation examines the effect of co-creation on health in a lifestyle intervention service aimed at increasing physical activity.

1.1 BACKGROUND

This study was inspired by recent advances in service research that present an interactive approach to value creation (e.g., Prahalad 2004, Vargo & Lusch 2008, Grönroos 2008). Service research addresses the idea that service can support customers in accomplishing their goals more efficiently and effectively (Normann 2001).

Service research has highlighted healthcare as an important application area for empirical studies (Berry & Bendapudi 2007). More specifically, Service-dominant logic (S-D Logic) has discussed the concept of co-creation of value. The co-creation concept has been linked to health context in the literature (Bitner et al. 1997; McColl-Kennedy et al. 2009; McColl-Kennedy et al. 2012). A recent call for service research in the health context provided a global research agenda for service research in the years ahead and noted the importance of improving well-being and health through service as one of the key contribution areas (Ostrom et al. 2010).

Factors that compromise health have changed dramatically in recent history due to an ongoing increase in the prevalence of chronic lifestyle diseases. In recent decades in affluent industrialized societies, chronic non-communicable diseases have replaced infectious diseases as primary causes of morbidity and mortality and are the main causes of both disability and death worldwide. This group of diseases includes cardiovascular disease, cancers, chronic respiratory conditions and diabetes, and affects people of all ages and social classes (Sassi & Hurst 2008; The World Health Organization 2003; Yach et al. 2004). Globally, of the 58 million deaths in 2005, approximately 60% were due to chronic causes. This burden is predicted to worsen by a further 17% by 2015 (Strong et al. 2005), resulting in an epidemiological crisis of chronic diseases. Diseases attributable to health behavior currently cause significant suffering and staggering economic cost (Bickel & Vuchinich 2000).

It is well known that many of the risk factors for chronic diseases are preventable and not ameliorated to improvement by medicine, the aging of the population, the widening social class gradient in health, or development of health policies. Many researchers believe that the most cost-effective way of

treating chronic diseases may be to prevent[1] them from occurring in the first place. These diseases could be prevented and managed to a large extent, if people would change their health behaviors (Proper & Van Mechelen 2008). Currently the most important risk factors leading to chronic diseases are all lifestyle related (Honka et al. 2011). Lifestyle plays a big part in the incidence of many chronic diseases, and some lifestyle trends such as increasing consumption of poor diets, adoption of sedentary behavior and the resultant obesity adversely affect population health (Sassi & Hurst 2008).

This dissertation focuses on physical activity, which is one of the important health behaviors to change, as society and lifestyles have become increasingly sedentary. The structure of modern societies tends to discourage physical activity. "Technology and economic incentives tend to discourage activity, technology by reducing the energy needed for activities of daily living, and economics by paying more for sedentary than active work" (Haskell et al. 2007, p.1082). The evidence for the links between physical inactivity and disease is strong. Lack of physical activity[2] has been estimated to cause, globally, about 10-16% of cases of breast, colon and rectal cancers, and diabetes mellitus and about 22% of ischemic heart disease (WHO 2002). Moreover, insufficient physical activity was estimated by the WHO in 2002 to cause 1.9 million premature deaths globally. The direct costs from consequences of lack of physical activity alone have been found to be approximately 2 and 2.4% of the annual national health care expenditures in Europe and the USA respectively (Colditz 1999; Proper et al. 2004).

Thus, the questions about health can no longer be reduced to advances in clinical medicine or to interventions performed on a passive patient. Instead it is critical to change and manage individual health behavior through service beyond the traditional healthcare service system. In the current system, clinical medicine is largely focused on curing disease, yet individuals are increasingly unable to manage and maintain healthy lifestyles independently (Christensen et

[1] "Preventive medicine refers to a medical specialty primarily concerned with prevention of disease to and the promotion and preservation of health in the individual" (National Library of Medicine). Prevention efforts target health behavior that is defined as "any activity undertaken by the individual, regardless of actual or perceived health status for the purpose of promoting, protecting or maintaining health, whether or not such behavior is objectively effective towards that end" (Nutbeam 1998, p.8).

[2] Physical activity has been defined as any bodily movement produced by skeletal muscles that result in caloric expenditure (Caspersen et al. 1985).

al. 2009). A fundamental realignment of resources to types of service that support managing healthy lifestyles may address this problem. These changes would benefit from being informed by empirical evidence of their efficiency and effectiveness at changing individual health behavior.

1.1.1 Defining health

There are a number of approaches to defining health. One might emphasize positive dimensions of health (e.g., well-being, quality of life) and contrast this with the disease-focused definitions. Some all-encompassing philosophically oriented formulations define health as synonymous with 'good life' (Buchanan 2000). Perhaps the most widely used definition is in the World Health Organization's constitution, which states, "health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (WHO 1948). This holistic definition emphasizes the positive in its reference to well-being. While this definition has been influential in the development of measures in the field, it is very broad and difficult to operationalize (Brazier & Ratcliffe 2007).

One of the most persistent distinctions between interpretations of health is embodied in Greek mythology and in the characters of Hygeia and Asclepius (Dubos 1987). The goddess Hygeia symbolized the virtues of living and well-being. Asclepius, the physician, represented the medical view of the world. These two different points of view still recur in contemporary debates about the purpose of promoting good health. This research follows the worshippers of Hygeia in exploring health and well-being; to them health is the natural order of things, a positive attribute to which they are entitled if they govern their lives wisely.

Holistic health definitions strive for attainment of physical, mental and social well-being, striving for the practically and logically impossible (Tones & Green 2008). Most criticism of the WHO definition concerns the word "complete" that in its absoluteness unintentionally leaves most of us unhealthy most of the time (Huber et al. 2011). Huber et al. (2011) highlighted the idea that the definition does not account for individual capability to adjust to physical, social and emotional changes, and people with a chronic condition are deemed

definitively ill no matter their capability to function with fulfillment and feeling of well-being.

Several dimensions of health are social, including an individual's capability to participate in social activities such as work and the ability to manage his life (Tarlov 1996). A new formulation for health has been proposed as the ability to adapt and to self-manage and health to be regarded as "a dynamic balance between opportunities and limitations, shifting through life and affected by external conditions such as social and environmental challenges" (Huber et al. 2011, p.2).

In this dissertation, only physical attributes of health with relatively straightforward clinical definitions are discussed as measures. Physical health is associated with increasing capability to function as a productive part of society, minimizing disease and disability. It may involve having a sufficient level of fitness necessary for achieving other, often more important, life goals.

1.1.2 Creating health

Currently most efforts to improve physical health are channeled through healthcare service systems. This practice reflects the common belief that receiving appropriate healthcare service is the most important determinant of overall health (Evans et al. 1994). Healthcare is one of the largest clusters of economic activity in developed countries (Schieber & Poullier 1989) and accounts for a steadily increasing share of gross national products. Limited resources, increasing demand, and misaligned funding incentives challenge healthcare systems globally. Historically, these systems have focused on cure versus prevention and on treating disease versus mitigating its onset (Nussbaum 2006, p.107). Healthcare today has a major role in individual and societal health, but it is overwhelmingly reactive in nature, responding to departures (illness, injuries) from health. Because of this, healthcare systems are often characterized as "illness care systems" as opposed to preventive care or wellness service. Timely and effective healthcare service may be an important determinant for how people recover from disease or injury, but as currently operated, it does not determine how and why people become sick or injured in the first place (Stoddart 1995).

From the provider perspective, a simple metaphor can describe healthcare. When something breaks or is damaged, it is fixed or replaced by a physician. This metaphor can be extended to service research where healthcare could be seen as service recovery for the process of maintaining and managing a healthy lifestyle. Service recovery implies a corrective move when something in a usual process goes wrong. Healthcare service is needed when the usual process of "staying healthy" fails.

As the industrialization accelerates and unhealthy lifestyles contribute to the deterioration of individual health, healthcare service systems in their current forms are not able to respond effectively. Despite growing evidence of the epidemiological and the economic impact of prevention and lifestyle choices, the global response to managing the problem remains inadequate. Most lifestyle related "diseases can be diagnosed by a physician, but following that diagnosis and a prescription, in many instances the physician's cannot add much additional value beyond teaching the patients broad categories of do's and don'ts" (Christensen et al. 2009, p.160).

Lifestyle is the aggregation of personal decisions that affect an individual's health and over which he more or less has control. Maintaining a healthy lifestyle depends on daily behavioral choices such as avoiding smoking, exercising, sleeping sufficiently and maintaining a healthy weight – all essential for an individual's physical health. In fact, behavioral choices are the most important factor (40%) influencing individual health (McGinnis et al. 2002) (Figure 1).

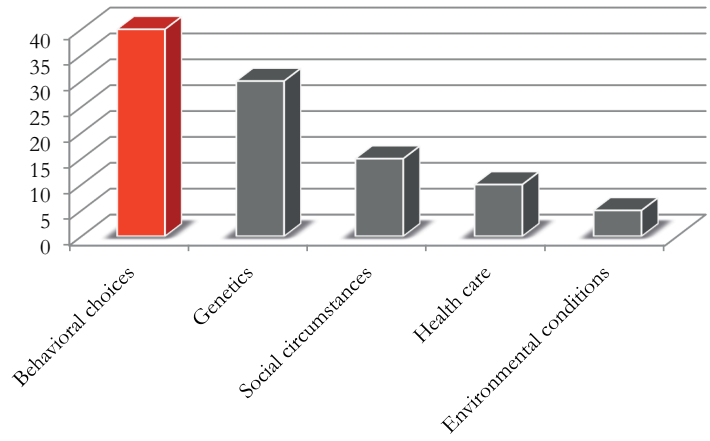

Figure 1: Factors affecting an individual's health (McGinnis et al. 2002)

As illustrated in Figure 1, an individual's health is affected by a number of factors. Different types of health care service contribute 10% of an individual's health. Social circumstances and genetics have stronger roles. These factors affecting an individual's health are interrelated.

At times, individuals do not sufficiently manage health behavior, and thus may require co-creation through a lifestyle intervention. A lifestyle intervention is an effort to influence an individual's daily practices through service. Lifestyle interventions most often target health behavior, although they have also promoted ecological, social, economic, and other behaviors. These types of service may promote good health behavior (physical activity, a diet rich in vegetables, use of sunscreen) or discourage unfavorable ones (smoking, drug use). Risk behavior accounts for specific forms of behavior that are associated with increased susceptibility to a specific disease or ill-health (Nutbeam 1998), such as smoking and lung cancer.

1.2 RATIONALE FOR LIFESTYLE INTERVENTIONS IN THE WORKPLACE

Employers are becoming increasingly interested in investing in the health of their employees and are hoping to capture value from these investments (Shephard 1992; Brouwer et al. 1999; Nurminen et al. 2002; Proper et al. 2003;

Burton et al. 2005). As a result, lifestyle intervention programs are increasingly implemented in occupational settings. The typical goals of these programs are to improve employee health and well-being, reduce absence and turnover, and/or increase productivity, motivation and job satisfaction (Proper & Van Mechelen 2008; Kristensen 2005; Hillier et al. 2005).

Health and wellness service spending in occupational environments is expected to pay for itself by improving employee work capability, which in turn produces wealth (Evans et al. 1994). This trend makes it necessary to discuss a number of theoretical, methodological and practical issues (Kristensen 2005). To the extent that health and wellness service directly contribute to health, they affect overall well-being both directly and indirectly through economic benefits of improved productivity and functioning (Evans et al. 1994). Though rationales for making investments vary, lifestyle intervention programs may yield a return on investment by reducing absenteeism and employee turnover, decreasing disability pensions, cutting employee health costs, increasing productivity at work, and/or enhancing a company's image (Aldana & Pronk 2001).

The work-place offers many opportunities for prevention, early detection, and management of chronic diseases. It is a potential setting for providing various lifestyle interventions that promote healthy behavior for the adult population (Proper & Van Mechelen 2008; Sorensen et al. 1999). For example, workplaces provide ease of access to a large number of individuals, many of whom are at risk for adverse health effects. Worksite interventions may also increase participation, as they are conveniently provided on-site. There is a potentially low level of friction, as the population is relatively stable. Cohesion of the working community can offer benefits such as positive peer pressure, support and established channels of communication that can advertise programs, encourage participation and share results (Peersman et al. 1998). As a research context, lifestyle interventions in the occupational setting offer a promising and a timely opportunity to empirically examine co-creation.

There is an abundance of different types of lifestyle intervention service available commercially. They are often used without evidence on their effectiveness in changing health behavior (Abraham & Graham-Rowe 2009; Proper et al. 2002; Dishman et al. 1998). In this dissertation, a pragmatic randomized controlled trial was conducted in order to analyze whether a 'real-

life' commercially available intervention service provides health benefits to the employees and subsequently affects other work-related outcomes.

1.3 POSITIONING OF THE STUDY

This dissertation is positioned in service research, focusing on service-dominant logic. The phenomenon of interest, the effects of co-creation on health, are empirically examined in the context of a lifestyle intervention service targeting physical activity in occupational setting. The phenomenon is explored primarily from the employer's point of view.

1.3.1 Service-dominant logic

Service has been in the interest of multidisciplinary literature for the past decades. Service management has been discussed in terms of underlying *logics*[3] (Edvardsson et al. 2005; Grönroos 2006; Gummesson 2007; Vargo & Lusch 2004; Vargo & Lusch 2008; Vargo et al. 2008b). New logics emerge from the convergence of advances in technologies, concepts, methods and theories (Callaway & Dobrzykowski 2009). Contributions to the service management literature have been increasingly active since Vargo & Lusch's (2004) article "Evolving into a Service Dominant Logic of Marketing" that organized 30 years of research into a service perspective (Berry & Parasuraman 1993) by responding to inadequacies of traditional, production-oriented goods-dominant logic. "Many tributaries are feeding the S-D logic, including services marketing, market orientation, customer relationship management, networked markets, mass customization and interactivity" (Day 2006, p.85). Initially, S-D logic had a marketing focus, but it was soon expanded to have repercussions beyond marketing and has been since applied widely. Its founding fathers see it as a generalizable mindset from which general theory of market can be developed (Vargo & Lusch 2008).

[3] Logic is the formal systematic study of the principles of valid inference and correct reasoning. Grönroos (2006) defines logic as a strategic mindset or a mental model; it is the underlying thinking that guides management practices.

The transaction-based model of exchange (value-in-exchange) has been criticized as a poor fit with the new service economy by S-D logic. From the 2004 article on, S-D logic has been contrasted with the goods-dominant model, which was inherited from economics and is based on manufactured outputs, to a model focusing on intangible resources and the co-creation of value and relationships. This idea, that value is co-created is characteristics of the departure from the goods-dominant thinking.

The foundational premises establish a framework for the service-centered mindset (Vargo & Lusch 2004; Vargo & Lusch 2008). Many of the concepts underlying this mindset – and thus the foundational premises – were not invented for S-D logic, nor are they exclusive to it (Table 1).

Table 1: Foundational premises (FPs) of S-D Logic (Vargo & Lusch 2008)

	Foundational premise
FP1	Service is the fundamental basis of exchange
FP2	Indirect exchange masks the fundamental basis of exchange
FP3	Goods are a distribution mechanism for service provision
FP4	Operant resources are the fundamental source of competitive advantage
FP5	All economies are service economies
FP6	The customer is always a co-creator of value
FP7	The enterprise cannot deliver value, but only offer value propositions
FP8	A service-centered view is inherently customer oriented and relational
FP9	All social and economic actors are resource integrators
FP10	Value is always uniquely and phenomenologically determined by the beneficiary

Three foundational premises have inspired this study and are central to the theoretical discussion. They are "the customer is always a co-creator of value" (FP6), "the enterprise cannot deliver value but only offer value propositions" (FP7) and "all social and economic actors are resource integrators" (FP9). S-D logic describes an ongoing process of voluntary exchange through collaborative, value-creating relationships among actors. In discussing these

foundational premises in this dissertation, this research primarily refers to Vargo and Lusch's 2008 article that presents the most recent iterations of foundational premises of S-D Logic.

S-D logic presents a view on value creation, in which the individual is seen as the active resource taking initiatives and managing value creation. The view of an active individual reflects the capabilities and resource integration required in lifestyle interventions targeting health behavior change. S-D Logic was chosen for the key theoretical foundation for this research for this reason.

The healthcare management literature reflects the same phenomenon when it refers to an empowered patient (Jones & Meleis 1993; Trummer et al. 2006; Wallerstein 1992). Empowerment is defined as a process through which people gain greater control over the decisions and actions affecting their health (WHO 1998). When empowered, people have sufficient skills, understanding, and self-efficacy to be responsible for their health (Honka et al. 2011). Empowerment is guided by the principle of self-determination and may be facilitated by health care providers (Aujoulat et al. 2007). Whereas in the more traditional compliance-oriented approach to health-care, patients are seen as the recipients of medical care, care guidelines and prescriptions, the empowerment-oriented approach views them as being responsible for their choices and the consequences. This idea is reflected in the literature in service research, healthcare management, lifestyle intervention research, health behavior, psychology, health economics and health promotion. This research draws from all of them in building the interdisciplinary approach to co-creation of health and in discussing the phenomenon.

Service-dominant logic offers concepts and ideas that can be applied to better understand the nature of value creation in lifestyle interventions and further in examining the effects of co-creation within a lifestyle intervention service relationship.

1.3.2 Pragmatic randomized trial on intervention effectiveness

An effectiveness trial was designed to examine effects of co-creation in a physical activity intervention service. Trials of health interventions are described as either explanatory or pragmatic. Explanatory trials generally

measure efficacy, meaning the benefit a treatment produces under ideal conditions, often using carefully defined subjects in a research clinic. Pragmatic trials measure effectiveness – the benefit the treatment produces in routine real-life practice (Roland & Torgerson 1998). The design of a pragmatic trial reflects variations between subjects that occur in a real-life practice and aims to inform choices between interventions. In order to generalize the results of a pragmatic trial, subjects are selected to resemble other individuals to whom the intervention would be applied (Roland & Torgerson 1998). The need for purchasers and providers of interventions to use evidence from trials in policy decisions has increased the focus on pragmatic trials.

Randomized controlled trials (RCT) are the gold standard for clinical effectiveness trials and the standard practice for the medical community to evaluate interventions. Randomization and the use of a control group enable isolating the possible effects of an intervention. If randomization is successful, any significant post-intervention differences between the groups can be attributed to the intervention and not to some unidentified factor. Subgroup analyses are used to further examine interaction for co-creation.

The case company selected the physical activity intervention service examined in this dissertation. The researcher had no input into selection or the content of the intervention. The commercially available intervention service model is widely used in Finland. It includes the core components (intention formation, specific goal setting, self-monitoring, feedback on performance, review of behavioral goals) that behavioral change theory recommends for changing health behavior (more detail is in Chapter 3).

1.4 PURPOSE OF THE STUDY AND RESEARCH QUESTIONS

Building on the empirical background and positioning of the study, the purpose of this dissertation is as follows:

The purpose is to examine the effect of co-creation on health.

Two research questions were formulated based on this research purpose to examine co-creation of health in the context of lifestyle intervention service.

Research question 1: How can co-creation of health be modeled?

This question explores how co-creation of health can be modeled in the context of a lifestyle intervention service. In order to increase understanding on the phenomenon and to make it accessible to empirical research conceptual models were built by extending previous research to include context specific characteristics.

Research question 2: What is the effect of co-creation in a physical activity intervention context?

This question is an empirical one built on the literature review and existing conceptual models. The empirical study was designed as a pragmatic randomized controlled trial that enabled examining effects of co-creation in a lifestyle intervention service. The trial examined a commercially available lifestyle intervention service, chosen by the case company, as it would have been implemented without the research component. The primary outcomes were changes in physical activity and work-related outcomes of sickness absence and productivity at work. Secondary outcomes were changes in physiological indicators of health. Empirical examination also analyzed interaction for co-creation within the service relationship and its effects on health behavior.

1.5 STRUCTURE OF THE DISSERTATION

The structure of the dissertation is organized as follows:

Chapter 2 *Co-creating health* reviews the literature on co-creation within the domain of service research, reflecting upon the phenomenon in the context of health service. The chapter is divided to three main sections. First the body of knowledge on co-creation in service research is presented. Special focus is put on co-creation within the domain of S-D logic. Second, the processes for co-creation are discussed. Third, health as a co-created outcome is discussed by combining health economics and health management discourses to S-D- logic view. The chapter concludes with a synthesis of the literature review, identified research gaps and presentation of three models on co-creation in health context.

Chapter 3 *Physical activity, health and productivity in the literature* presents previous research related to the empirical context of lifestyle interventions in the occupational setting. First, theoretical assumptions behind the value creation logic for the employer are presented. Then discussion is focused on physical activity interventions, by reviewing benefits of physical activity and previous research in the occupational context. In order to discuss the third party interest of lifestyle interventions health and capability are discussed as value. The chapter concludes in a presentation of identified research gaps in the literature on physical activity interventions in the occupational context.

Chapter 4 *Research approach and methodology* presents the research approach and methodology. Randomized controlled trial (RCT) is introduced as core methodology for outcome analysis of the intervention service. The RCT is anchored to realist ontological and epistemological approach in order to further analyze and discuss co-creation of health in an open system. In this chapter the research protocol for CoAct, a randomized controlled trial is presented and methodological choices discussed. Data collection instruments and their validity and reliability discussed.

Chapter 5 *Results* presents the findings of the empirical examination of co-creating health through a lifestyle intervention targeting at increasing physical activity. First, enrollment and participation in the study are explained. Then the effect of co-creation on health is analyzed by examining effectiveness of the intervention. Final part of the chapter analyzes interaction for co-creation.

Chapter 6 In the final chapter the contribution of the research is discussed and assessed from theoretical and empirical perspectives. The managerial implications are presented. Limitations and generalizability are discussed and methodological considerations presented. Finally, the chapter concludes with proposals for future research and conclusions.

CHAPTER 2

CO-CREATION IN THE LITERATURE

This chapter reviews the literature on co-creation within the domain of service research, reflecting upon the phenomenon in the context of lifestyle intervention service. The chapter is divided to three main sections. First, the body of knowledge on co-creation in service research is presented. Special focus is put on co-creation within the domain of S-D logic. Second, the processes for co-creation of value are discussed. Third health as a co-created outcome is discussed from an interdisciplinary approach. The reviewed literature is synthesized in at the end of the chapter together with a summary of the identified research gaps.

> "Despite the fact that health care is the most obvious case of co-creation of service, it is still approached as if doctors do something to patients and patients get well, doctors being operant resources and customers being operated on, thus being passive resources" (Gummesson 2010, p.633).

Recent service management research has explored a focus shift among service providers from internal efficiency to increasing efforts to leveraging external resources. In particular, customers are leveraged in order to create value and gain competitive advantage (Lovelock & Young 1979; Prahalad & Ramaswamy 2004b; Prahalad & Krishnan 2008). Rather than being seen as passive recipients of service, customers have been recognized as having active roles in the creation and provision of service, as well as in the realization of its value

(Prahalad & Ramaswamy 2000; Vargo & Lusch 2004; Xie et al. 2008, Nordgren 2008).

In health service, a similar shift is imminent due to the scarcity of resources and the need to increase cost-effectiveness. This shift is also driven by the realization that in order to tackle lifestyle related diseases, health creation processes must change. Co-creation of health increasingly extends outside the traditional service setting of the physicians office or a hospital into everyday life where health behavior takes place. Health care providers are seeking opportunities for prevention and better disease management through co-creation efforts in order to decrease the cost of care. They include increased prevention efforts, chronic care programs, and lifestyle interventions.

In recent years, co-creation has gained increasing attention in the health and wellness industry; customer participation and new ways of delivering value have been explored as avenues for advancing the quality and value of the service offerings (Hibbard 2003; Ouschan et al. 2006).

2.1 CO-CREATION IN THE SERVICE LITERATURE

The concept of co-creation was introduced by Prahalad and Ramaswamy (2000). It has since been further defined and strongly advocated by proponents of the service management literature (Prahalad & Ramaswamy 2004b; Prahalad & Ramaswamy 2004a; Grönroos 2006a; Grönroos 2008) and service-dominant logic (Lusch & Vargo 2006; Vargo & Lusch 2008). Co-creation has primarily been applied to describe joint value-creation efforts between service providers and their customers. Co-creation implies that value creation is interactional (Vargo & Lusch 2008). The emerging body of literature on co-creation is largely conceptual in nature (Zhang & Chen 2008).

According to S-D logic, service is "an inclusive term, with goods representing a mechanism for service provision" (Gummesson et al. 2010, p.11). S-D logic sees that service, the application of competencies for the benefit of another, is the fundamental basis of value creation through exchange. Services are

exchanged for other services[4] and goods when involved, are service provision vehicles (Vargo & Akaka 2009). S-D logic distinguishes itself from the traditional paradigm of economic exchange (Goods Dominant Logic) that suggests goods (tangible products) are primary over service or add-ons (Vargo & Lusch 2004; Vargo & Lusch 2008).

Discussions revolving around the S-D logic have advanced views on value co-creation and have clarified the fundamental underpinnings of the phenomenon (Vargo & Lusch 2008; Vargo & Akaka 2009). Proponents of S-D logic have proposed that customers are always value co-creators (Vargo & Lusch 2008) and that a service provider can become a co-creator if the customer accepts his value proposition. The roles of producers and consumers are not always distinct in S-D logic. This idea means that value is "always co-created, jointly and reciprocally in interaction among providers and beneficiaries through integration of resources and application of competences" (Vargo et al. 2008, p.146). Value is seen as co-created at the intersection of two or more value creation systems (Vargo & Akaka 2009).

Co-creation has also been discussed by the representatives of the Nordic School (Grönroos 1991; Gummesson 2008) who characterize it primarily as interaction for value creation within a service relationship (Grönroos 2008; Heinonen et al. 2010). The Nordic school refers to *service logic* (Grönroos 2006) and *customer dominant logic* (Heinonen et al. 2010) in addressing value creation. Despite these and other differences in definitions, service logic and S-D logic are not alternative perspectives. Rather, they complement each other in forwarding mutual interest in service and value creation (Grönroos 2011a). The research presented here sees the logics as contributing to one another, often by scrutinizing and challenging them for further definition.

Although discussions are currently published on the topic and several definitions for value co-creation have been presented (Table 2), there is no unified view on the definition or nature of value co-creation.

[4] In the S-D logic, the singular term "service" does not refer to "the opposite of goods", but to a process of doing something for someone, where goods are used as appliances in service provision. The plural 'services' is seen as implying units of output as would be consistent with G-D logic (Lusch & Vargo 2006, p.282).

Table 2: Definitions and perspectives of value co-creation in service literature

Author(s)	Definition or perspective	Interpretation
Prahalad & Ramaswamy (2000)	Customers want to shape experiences themselves, both individually and with experts or other customers.	Introduction of the co-creation concept. It highlights the trans-formation of customers from passive to active players.
Prahalad and Ramaswamy (2004)	Co-creation relates to joint creation of value by the company and the customer.	Co-creation is presented as an interactive concept and linked to value creation.
Lusch & Vargo (2006)	The S-D Logic notion of value co-creation: no value exists until an offering is used.	Co-created value is assessed as value in-use.
Vargo & Lusch (2008)	Value obtained with market exchanges cannot be created unilaterally. It always involves a unique combination of resources and an idiosyncratic determination of value.	Value is created collaboratively in interactive configurations of mutual exchange and through resource integration.
Payne, Storbacka and Frow (2008)	The value co-creation process involves the supplier creating superior value propositions, with the customer determining value in consumption.	Customer judgment determines value.
Ordanini & Pasini (2008)	Co-creation means that value, enhanced by a business service, also depends on resources and competencies existing in the customer's organization.	Business to business emphasis, where value co-creation is seen as dependent on engagement of customer's resources.
Gummesson (2008)	The focus should not be on one-party centric (supplier- or customer-centric) but on two-parties, which simultaneously focuses on suppliers and customers.	"Co-creation of service is a neces-sity" (p. 16). Service is created in network of activities involving a host of stakeholders.
Ramaswamy (2010)	Co-creation means meaningful engagement of individuals based on human experiences, through engagement platforms to mutually expand value.	Co-creation is about engagement.
Grönroos (2011)	Together with another party (co-create) the customer is always involved in value creation.	Fundamentally, the customer is always a value creator. Co-creation of value can take place only if interactions between the firm and the customer occur.

Vargo & Lusch (2011)	All parties engaged in economic exchange are similarly, resource-integrating, service-providing enterprises that have the common purpose of value (co-)creation.	All actors are resource-integrating co-creators of value.
Grönroos & Ravald (2011)	Joint activities by parties involved in dyadic direct interactions aiming at contributing to value that emerges for both parties.	The dyadic service relationship context is highlighted.
Ramaswamy (2011)	Co-creation is the process by which mutual value is expanded together.	Value to participating individuals is a function of their experiences.
McColl-Kennedy et al. (2012)	Customer co-creation is the benefit realized from integration of resources through activities and interactions with collaborators.	Value is co-created in the customer's service network. Activities and interactions are used to describe customer's co-creation of value.

As Table 2 shows, co-creation is most often discussed as a joint process between a customer and a service provider. Terms reflecting collaboration and interaction are used to describe co-creation and interaction is a central term in co-creation research. It has been defined as "mutual or reciprocal action where two or more parties have an effect upon one another." (Grönroos 2011b, p.289). Interaction and activities are the way for individuals to engage in resource integration within a service network (McColl-Kennedy et al. 2012). The parties involved are in contact with each other and have opportunities to influence one another's value creation processes (Grönroos 2011b). Prahalad and Ramaswamy (2004b) see co-creation as highlighting consumer-company interaction as the locus of value creation. Within service relationships, interactions take place in service encounters (Grönroos 2011b).

The only health-context-specific definition of co-creation has been defined as "activities with self in collaboration with members of the service delivery network including self, family, friends, other patients, health professionals and the outside community" (McColl-Kennedy et al. 2009, p.11). The co-creation activities are recognized as *doing* (cognitive or behavioral) that can be represented by various activities involving the effort of the customer (McColl-Kennedy et al. 2009). Payne et al. (2008) had already earlier extended a call for research to better understand what 'doing' is in the context of co-creation.

Customers have been recognized as contributing to the co-creation of value through their own self-generated activities (McColl-Kennedy et al. 2012). Activities in co-creation will be further discussed throughout this dissertation.

According to the sixth foundational premise of S-D logic (Table 1), the customer is always a co-creator of value. This implies that the customer is always involved in the value creation process. Vargo and Lusch (2008) understand co-creation to take place between any resources, such as the provider and the resources the customer already possesses. Grönroos (2011) challenged the S-D logic view on co-creation by stating that it is correct only to the extent that is says a customer is always involved in value creation together with another party (co-create). Grönroos focuses the discussion of value co-creation on service relationships. McColl-Kennedy et al. (2012) pointed out that in health, resource integration extends beyond the traditional healthcare setting into self-driven activities.

In examining lifestyle interventions the specific interest is in how an individual's health may be boosted through interactions within a service relationship. Thus, the scope of examining co-creation in this dissertation is in a specific service relationship. Whether value is always co-created (Vargo & Lusch 2008) or sometimes independently created by the customer in what Grönroos refers to as 'sole creation' (2009) or 'independent value creation' (2011a) depends on the view of the resources integrated to co-creation.

Value creation requires specific resources and capabilities depending on the context. S-D logic distinguishes between operant and operand resources in value creation (Table 3). Service is seen as the application of operant resources, such as knowledge and skills (Vargo & Lusch 2008).

Table 3: S-D logic distinguishes operant and operand resources in value creation.

- **Operant resources** are capable of acting upon other resources to create value (e.g., knowledge, skills)
- **Operand resources** must be acted on to derive benefit (e.g., goods, natural resources, and money)

(e.g., Vargo & Lusch 2004; Vargo & Akaka 2009)

Neither operant nor operand resources have value per se, but a customer can co-create value by using and combining them in various ways (Tronvoll et al. 2011). In order to so, operant resources are employed to act on operand resources and other operant resources. Customers are seen as active, operant resources taking their own value creation initiatives. In the health creation and management, an individual is seen as the most important resource integrator. Individuals are sometimes capable of co-creating value with their existing resources. At other times, they need support through service.

In the context of lifestyle, this idea implies that some people, for instance, may be capable of using existing resources and motivating themselves with existing knowledge. For example, they will don their running gear (operand resource), log miles run and create health benefits with sufficient physical activity independently of any provider contact. Individuals in different situations, however, may need the assistance of a lifestyle intervention specialist (operant resource) in order to change health behaviors. As an individual's situation and health status changes over time, their capability to perform all health creating tasks independently may change, and service interventions may be needed to support creation of health (co-creation). The value proposition of a lifestyle intervention service is that it helps customers complete a goal they wish to achieve more effectively, conveniently and affordably (Christensen et. al., 2009).

An individual may be "nudged" to change their priorities regarding health behavior choices by an employer. The term nudge describes any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing economic incentives (Thaler & Sunstein 2008). Nudging implies an approach to behavior change that focuses on altering environmental cues to prompt healthier behavior such as lighting the stairwell brightly and making elevators slow and dark, providing new fitness facilities or constructing walking tracks around the workplace. These ideas build on psychological and sociological theory that show how environments shape and constrain human behavior (Marteau et al. 2011). Environmental factors can help or hinder physical activity (Dishman & Sallis 1994). Research has identified environmental modification as a potential way of changing physical activity and dietary behavior, and significant short-term effects have been found (Engbers et al. 2005; Matson-Koffman et al. 2005; Engbers et al. 2007; Engbers & Sattelmair 2009). The context in which these

cues are presented also affects behavior (Ariely 2009). Operand resources and their availability, such as availability of sidewalks in the neighborhood, may have noticeable affects on health behavior (King et al. 2006; Saelens et al. 2003). Although extensive research has been conducted on these issues the evidence to support the effectiveness of nudging as a means to improve health remains weak (Marteau et al. 2011). Nudges and choice architectures are here understood as operand resources.

2.2 VALUE IN THE HEALTH CONTEXT

Although health is frequently paralleled to value in pragmatic terms, the relationship is not straightforward. Value has been discussed in various discourses and has been assigned multiple meanings and definitions (Zeithaml 1988; Gale & Wood 1994; Holbrook 1994; Woodruff 1997; Priem 2007; Vargo & Lusch 2004). The value concept typically implies some form of an assessment of benefits against sacrifices (Sánchez-Fernández et al. 2009) and has often been defined as the tradeoff between the benefits ("what you get") and the sacrifices ("what you give") (Zeithaml 1988, p.14). It is seen as an outcome of evaluative judgment[5] (Holbrook 1994), and it suggests an interaction between a customer and a product or service (Payne & Holt 2001). Different conceptualizations of value have emerged that extend "benefits" beyond the notion of economic gain. Ideas about sacrifices also extend beyond an initial purchasing price and include, for example, the cost of ownership. Such extensions add important insights, but do not challenge the fundamental notion that value is a relation between benefits and sacrifices.

Two different sides to value have been recognized: value for the customer (experienced) and financial value (revenue) for the service provider (Gupta & Lehmann 2005; Osterwalder 2010). The two sides are interrelated. Customer value is commonly defined as perceived by a customer rather than determined by a service provider (Woodruff 1997). For example, Woodruff (1988) defined value as the customer's overall assessment of a product's utility based on

[5] A distinction must be drawn between the term *values* which refers to the standards, rules, criteria, norms, goals, and ideals that serve as the basis for evaluative judgement relating to value (Holbrook 1994; Holbrook 1999).

perceptions of what is received and what is given. Customer satisfaction derived from having goods is usually called utility by economist (Kreps 1988; Douma & Schreuder 2008, p.23). Healthcare economics (the field of economics applied to health), adopts utility as the primary concept of value (see Chapter 2.2.2).

2.2.1 Temporal changes in value of health

Ravald and Grönroos (1996) recommended that the trade-off between benefits and sacrifices should not be restricted to single episodes. Instead, customer-perceived value should consider episode and relationship benefits and sacrifices. The fundamental idea in different types of lifestyle intervention service is that co-creation of value started within a service relationship should accumulate beyond the service relationship, and possibly throughout an individual's life.

Several theories explaining health behavior incorporate the idea that the importance of health to an individual influences that individual's behavior with respect to health (Smith & Wallston 1992). People however tend to behave paradoxically. "They do things they later wish they had not done, and they fail to do things they later wish they had" (Bickel & Vuchinich 2000, p.193). Resolutions to start a new way of life acknowledged to have positive consequences on health often fail quickly because short-term rewards are preferred over future outcomes. Individual time preferences are a fundamental personal characteristic, and individuals discount future value to varying degrees. This phenomenon, known as temporal inconsistency, is strongly apparent in health-related behavior (Camerer et al. 2003)

An individual's short and long term preferences often oppose each other and individual preferences also change over time. The future, which long-term health preferences relate to, is seen as distant, abstract, and uncertain. Meanwhile, negative health behavior takes place because individuals tend to prefer immediate, more tangible rewards (e.g., one more glass of wine isn't going to hurt). Although people tend to say they prefer long-term health benefits to short-term pleasure, behavior patterns tend to contradict this idea

(Bickel & Vuchinich 2000). Health related preferences involve trade-offs between efforts that may produce a benefit at a later stage and other, more immediately valuable, objects of choice (e.g. Will I exercise to lengthen my life decades from now or watch an interesting program on TV right now?). It has been found that the relative attractiveness of long-term rewards decreases as the relative attractiveness of immediate gratification increases (Chapman & Johnson 1995). In order to stay healthy to improve health, an individual must rather continuously make positive health-related choices.

Health behavior change includes a variety of social, emotional, and cognitive factors that are interrelated to some extent. Therefore, researchers have aimed at identifying an optimal set of factors that allow for the best prediction or explanation of health behavior change (Abraham & Michie 2008). Studies examining the relationship between the stages of change in physical activity behavior and motivation have shown that extrinsic factors, particularly bodily factors such as appearance or body weight, are more important in the early stages of behavioral change, whereas intrinsic motivation such as enjoyment is more important for progression and maintenance of regular physical activity (Ingledew et al. 1998). Those who believe physical activity has little value for health and fitness and also believe health outcomes are out of their control have been found to engage in physical activity less frequently and to drop out of programs sooner than those holding opposite views (Dishman 1982). Knowledge of and belief in the health benefits of physical activity may motivate initial involvement, but feelings of enjoyment and well-being seem to be stronger motives for continued participation in corporate programs (Morgan et al. 1984). Motivation and self-efficacy are often referenced factors in behavior change, which change over time and may be influenced by the social context. Such factors, models and theories are primarily subject to debate in health psychology, which is out of the context of the present dissertation.

2.2.2 Health economics on producing health

To date, health economics discourse has presented the most thorough discussion of how value is created and the related processes in health context. Health economics research on health production is here compared to service research view of co-created value. In health economics, value has not been discussed as co-created, but primarily as produced by the service system and as exogenously entering the customer's utility function, much like a commodity.

Health economics has been mainly *healthcare* economics; ideas have been presented regarding the production processes underlying the health of populations. Two distinct branches of economics are reflected in health economics: 1) the use of economic theory to explain the operation of healthcare systems and make predictions about them and 2) the use of theory to facilitate decision-making on the most efficient use of resources (Kernick 2002). Studies of health consumption and production in health economics date back to the household production framework (Becker 1965) and the model of demand for health (Grossman 1972). The models are examples of the relatively few economic studies related to health determinants outside the traditional healthcare system (Stoddart 1995).

A central concern of health economics research has been whether or not health is a commodity. Fuchs & Zeckhauser (1987) saw health as a commodity that enters into an individual's utility. They note that the supply of health is not unlimited, but can be increased through the use of resources. Although health may have commodity-like features such as price, it is difficult to trade health interpersonally and its valuation is affected by significant independent utilities. For example, commodities are generally produced by specialists and then sold to the general public. However, an individual's health status is largely self-produced and is strongly affected by a person's consumption of other resources (Fuchs & Zeckhauser 1987).

A frequently referenced health economics model by Michael Grossman (1972) views each individual as a producer of health and a consumer of different types of healthcare service. This model reflects the commonly accepted view in health economics discourse on producing health through service. In the model, health is treated as a stock that degrades over time in the absence of "investments" in health. The model acknowledges that health care is both a

consumption good that yields direct satisfaction and utility, and an investment good that yields utility to consumers indirectly through increased capability.

In making health investments, individuals make tradeoffs between commitments time and resources. For instance, they weigh exercising or cooking healthy meals against other demands on their time and other goals. They attempt to maximize utility by balancing their time between two competing production processes: health and other commodities. Goal prioritizations and use of resources determine the optimal level of health that an individual will demand (Chapter 2.2.3). The core of the Grossman model is a function in which an individual integrates various external inputs, such as different types of service (e.g., medical care), and self-administered inputs (e.g., exercise or other preventive measures) to improve health. While an individual's limited time resource can be allocated to health, time is also required for other utility-increasing commodities, such as work, leisure, or social activities.

Different types of health service consumed by an individual are often co-produced[6] by numerous health provider resources. For example, a diabetes care episode may include primary and secondary care, a dietician, an optometrist, and numerous other resources working to manage an individual's health. Although Grossman does not explicitly talk about co-production, health production is modeled as a multiproduct function, implying a total offering produced by multiple providers. In so doing, multiple provider resources are allocated to an individual's health value creation (utility function).

Modern theories of an individual's production of health (Grossman 1972; Grossman 2000; Wagstaff 1986) suggest that individuals have different capabilities for transforming various inputs into 'health.' Hence, different types of health care service are not the only inputs seen as entering an individual's utility function. Additionally, lifestyle, education, habits, environment, and social circumstances are also included. Individual characteristics and other factors beyond the influence of providers may contribute to treatment success, and it is difficult to separate confounding effects from the health contributions made by health care organizations.

[6] According to Lusch and Vargo (2006) co-production "involves participation in the core offering itself. It can occur through shared inventiveness, co-design, or shared production of related goods, and can occur with customers and any other partners in the value network"(Lusch & Vargo 2006).

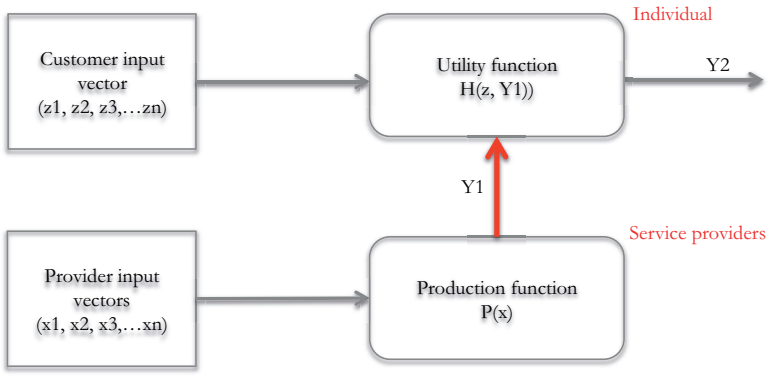

Figure 2: Abstraction of the Grossman model (1972)

As illustrated in Figure 2, Grossman modeled a production function that creates health service outputs (Y1) and a customer's utility function where service outputs are entered exogenously. The exogenous inputs are assumed to be of utility for the customer as such. Input vectors[7] in the Grossman model resemble resource integration in S-D Logic, in that multiple inputs feed the production as well as the utility function. Inputs between a vector can be interrelated. Both input functions consist of integrated inputs (resources), which are X1…Xn and Z1…Zn respectively. A customer's utility function consists of integrated resources and the Y1 service input from the provider.

The Grossman model did not account for the effects of interaction between the customer process and the provider function. This lack of co-creation in the model is addressed in section 2.5.

2.2.3 Health as a capability

Utility has been criticized as a measure of well-being (Sen & Williams 1982). Preference- and satisfaction-based models are rejected as "utility… is concerned with what these things do to human beings, but uses a metric that focuses not on the person's capabilities but on his mental reaction" (Sen 1980, p.218). In other words, the real interest is in what people are actually able to do or be.

[7] A vector is a set of real-valued random variables that may be correlated.

According to the Capability approach[8] by Amartya Sen, health service should not be evaluated based on ability to achieve utility, but to the extent that the service enhances an individual's capabilities and abilities to perform socially desirable functions. Health related functioning is related to the context in which an individual functions in everyday life, doing things at home, at work, or during leisure time. Nussbaum and Sen pointed out that "functioning" is a more rational measure of well-being and health than prosperity or utility (Nussbaum & Sen 1993).

Functionings are achievements that result from a person's resources and the capabilities they have (Sen 1992, p.39). They are 'beings and doings', or various states of being and activities that a person can undertake (Sen 1992). Examples of functionings are the state of good health or being well-educated. The functionings relevant for well-being can be elementary, such as avoiding illness, being adequately nourished, or having mobility, or complex ones such as being happy, achieving self-respect, or participating in the life of the community (Nussbaum & Sen 1993). Functionality is amenable to objective measurements such as life expectancy, physical independence or freedom from illness. Functionings are outcome-based measures, as opposed to resource-based measures (Kuklys 2005). While *being* can be interpreted as health status in the context of this dissertation, *doing* is required (e.g., sufficient physical activity) to improve health. Individuals can integrate products and different types of service in order to achieve a level of functionality in life, but the level of functionality achieved is dependent on numerous factors beyond the products and services used.

Capability denotes an individual's opportunity and ability to generate valuable outcomes, taking into account relevant personal characteristics and the context (Sen 1999). An individual's capability "reflects the alternative combinations of functionings the person can achieve, from which they can choose a collection" (Sen 1993, p.31). Thus, capability reflects the individual's freedom to lead one type of life or another (Sen 1992, p.40) and the ability to utilize resources effectively (Storbacka & Nenonen 2009). For example, an individual might be able to improve their health with a healthy diet, but might choose not to. It is

[8] The capability approach was initially conceived in the 1980s as an approach to wellfare economics. It is "an evaluative framework for individual wellfare" (Kuklys 2005), measuring it beyond income. It has since been applied more broadly to discuss health as a capability.

important to note that individuals seek better health not only because it makes their lives more pleasant (the classic utilitarian focus), but also because having a healthy life enhances the capability to achieve other goals (Sen 1999). Thus, good health is sought for expanding a person's important capabilities. For an employer, the potential work related outcomes (such as decreased sickness absence and increased productivity) achieved through a lifestyle intervention reflect employees' increased capability to work productively.

Sen and Nussbaum alluded to the fundamental nature of health as a capability of fundamental importance in its own right and instrumental to other capabilities. In line with ideas presented by Sen (1999), modern health economy theories of production of health (Grossman 1972; Wagstaff 1986) suggest that individuals have different capabilities for transforming various inputs into health.

2.2.4 Contextually determined value

Capabilities can be seen as value that is contextually determined (Sen 1999). In line with this, S-D Logic has recognized that value is assessed differently depending on the context. For example, the same service may be perceived differently by different customers or by the same customer on different occasions in a different social context (Edvardsson et al. 2011). It has therefore been suggested that the term value-in-use should be replaced with the term value-in-context (Vargo 2008) to better reflect S-D logic's 10th foundational premise: value is always uniquely and phenomenologically determined by the beneficiary (Table 1). Vargo and Lusch view value as "idiosyncratic, experiential, contextual, and meaning laden" (2008, p.7). Value is seen as determined in the individual's context and in their respective lifeworld (Helkkula et al. 2012). This heterogeneity between individual contexts affects how resources are drawn upon for co-creation (Chandler & Vargo 2011).

Edvardsson et al. (2011) extended value-in-context to be understood as value-in-social-context. They proposed that value co-creation is shaped by social forces in addition to resources that have been the focus of much of the S-D Logic literature. Context includes more than just resources. Individuals utilize resources uniquely within their social systems, and social systems affect their

resource integration and assessment, the perception of value, and their processes of value co-creation (Edvardsson et al. 2011).

Context has been understood as having three levels: micro, meso, and macro (Chandler & Vargo 2011).[9] According to Chandler and Vargo (2011) exchange at a micro-level takes place in reciprocal dyads between individual actors and consists of direct service-to-service exchange. The service exchange in a dyad always takes place in a wider value-configuration space, as both parties are resource integrators and involved in wider networks (Vargo 2009). The meso-level consists of triads of indirect and direct service exchange. And finally, at the macro context, the context of exchange of exchange is a complex network, where exchange is framed as it occurs among triads.

The notion of a complex network is of fundamental importance to this research, as multiple actors, dyads and triads in simultaneous direct and indirect interactions for co-creation affect an individual's health. However, in this dissertation, the unit of analysis is a triad in order to analyze effectiveness of a service regardless of heterogeneous value creation contexts of the individuals.

In this dissertation health is related to value. Seeing health as a capability and value as contextually determined differs significantly from the utility oriented view of health economics, where value is seen as exogenously produced for the customer. When applying these ideas to Sen's capability approach, health service should be evaluated not on the basis of its ability to satisfy utility, but to the extent that it enhances the capabilities of individuals and their abilities to perform value adding activities within their respective social contexts. Individual and contextual determination of value are seen as affecting how resources are drawn upon for co-creation; it thus affects co-creation of value in service relationships.

[9] Chandler and Vargo (2011) also included a meta-layer covering all three levels of context. The meta-layer frames service ecosystems and their evolvement over time.

2.3 VALUE CREATION PROCESSES

In service research, value creation is seen as a process that increases a customer's well-being (Vargo, Maglio, Akaka, 2008) and leaves him better off in some respect (Grönroos 2008). Vargo et al. (2008) raised a question to explore the exact processes involved in value creation. Payne et al. (2008) also highlighted the importance of understanding processes as procedures, mechanisms, activities and interactions that support the co-creation of value. In managing their health, individuals can simultaneously be objects of health service production, taking part in co-creation and capable of creating health independently with existing resources. To distinguish between these, the concepts episode and process are further clarified.

2.3.1 Episodes and processes

Unlike many other types of service, healthcare is typically provided in a series of separate but related service encounters (Hornbrook et al. 1985). The chain of service encounters that a patient experiences is often referred to as an *episode* in the healthcare management literature (Solon et al. 1967; Brailer & Hackett 1997). Healthcare episodes have also been discussed from the provider perspective (Hornbrook et al. 1985; Claus et al. 1997). A healthcare episode has been defined as a series of health-related events with a beginning and an end, which are related to a particular health problem that exists continuously for a limited time (Hornbrook et al. 1985). From the healthcare management perspective, a process is a provider's sequence of production steps for handling certain types of repetitive operations.

An episode, on the other hand, expresses what actually happened to an individual customer in retrospect (Figure 3). Ideally, the episode and the process are the same, but in practice they may deviate significantly from one another - especially in health maintenance.

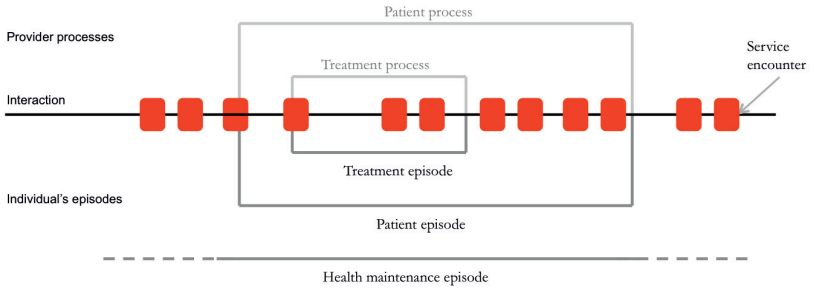

Figure 3: Individual's episodes and provider processes

Figure 3 shows that there are essentially three types of episodes: 1) treatment episodes, 2) patient episodes, and 3) health maintenance episodes. A patient episode is typically launched by a health issue and ends when it is resolved. Health maintenance episodes can be started without an existing health issue or identified risk of such and can have a purely preventive purpose.

To explain episodes, it is useful to discuss the provider's process perspective. During treatment or care, an individual becomes a customer of one or more providers. In a treatment process, the individual is actively treated for a medical condition. Treatment processes vary in length and intensity. Episodes and processes may differ from one another in length or sequence and several providers and their service processes may be involved in one patient episode.

A health maintenance episode is a continuum of activities related to maintaining health and improving it. It includes such things as health education, exercise and nutrition programs, smoking cessation programs and weight loss programs (Hornbrook et al. 1985). An episode of lifestyle intervention service may be short and involve only a single visit, such as a healthcare provider advising a patient how to stop smoking. Alternatively, a health maintenance episode may last a person's lifetime such as with treatment for alcoholism. Possible lifestyle changes achieved as an outcome of a lifestyle intervention service relationship are expected to be carried forward continuously without an active service relationship.

For the remainder of this dissertation, episodes and processes are discussed in the scope of co-creation within a service relationship. The fundamental notion to be carried forward from episode and process discussion is the different time span of health maintenance episodes (lifestyle interventions) compared to traditional healthcare treatment episodes.

2.3.2 The co-creation process

The co-creation process refers to interaction between a provider and a customer in order to create value. It is a process, which increases a customer's well-being (Vargo et al. 2008). This process has been recognized as having fundamental importance in service research (Vargo & Lusch, 2008) and it has been addressed in recent scholarly work (e.g., Dong et al. 2008; Etgar 2008; Flint & Mentzer 2006; Jaworski & Kohli 2006; Kalaignanam & Varadarajan 2006; Lambert & García-Dastugue 2006; Oliver 2006; Payne et al. 2009; Xie et al. 2008). Co-creation of value is not seen as a homogenous process, but rather as one for which there can be multiple approaches (McColl-Kennedy et al. 2009).

Grönroos (2007) observed that customers' value generating processes and the process where service is created take place simultaneously to a large extent: the co-creation process occurs when a customer consumes, or uses, a service. During an individual's lifetime, health is co-created together with numerous resources and related encounter processes of varying lengths are formed with service providers (Figure 4). Several different health forwarding and lifestyle supporting service can be consumed simultaneously, and they may at best co-create value in concert with each other.

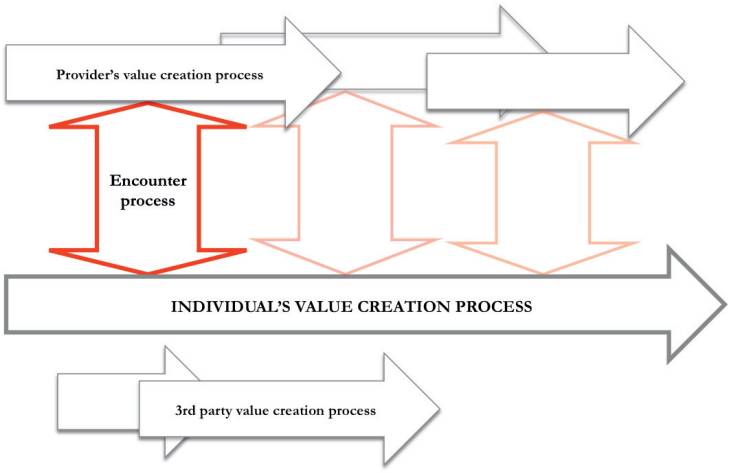

Figure 4: Customer value creation process and related processes of service providers and third parties

Interaction and exchange for co-creation of health can take place in relatively discrete instances or specific episodes, but the effects on outcomes and value may unfold over extended periods. An individual's value creation process related to health can be seen as a lifelong continuum from birth to death (Figure 4). This continuum involves daily activities, resource integration choices, treatment episodes, patient episodes, and health maintenance episodes and it does not stop when a service relationship ends. The unfolding, co-creational nature of value is relational in that the activities of all parties interactively and interdependently combine, over time, to create value (Vargo 2009). This is significant in health maintenance where value is co-created through several interdependent activities and affected by a network of operant and operand resources. S-D logic conceptualizes relationships through the joint, interactive, collaborative, and reciprocal value co-creation (Vargo & Lusch 2008; Vargo 2009) presenting a view that has not been incorporated to lifestyle management context exhaustively.

Figure 4 also introduces a third party value creation process, which is of particular significance in the context of this dissertation. This process is a specific component enabling health and wellness service provision in the occupational context and in publicly funded healthcare. This idea will be further developed by modeling co-creation as a triad and by extending relationship performance measures to account for third party value capture (Chapter 2.5.2).

2.3.3 Dyadic co-creation relationships as part of a network

Co-creation of value has been characterized as a networked phenomenon (Achrol & Kotler 2006; Grönroos 2006b; Gummesson 2006; Lusch & Vargo 2006). Interaction and networks have been proposed to play a more central role in value creation than is immediately apparent in S-D logic (e.g., Achrol & Kotler 2006; Grönroos 2006b; Gummesson 2006; Lusch & Vargo 2006). Recent literature has mainly modeled co-creation as dyadic business-to-business (B-2-B) relationships (Payne et al. 2008; Storbacka & Nenonen 2009). Networks consist of multitude of dyads that may be interconnected (Anderson et al. 1994). The dynamics and the structure of a value creation network change over time along with an individual's needs and preferences.

A network of different types of service (not only health or wellness specific) affects an individual's health in varying ways. Health-promoting or -degrading encounters can happen with the same provider depending on circumstances. Consider, for example, choices made at grocery stores. Some days, an individual makes healthy purchasing choices, whereas on other days the same person's shopping cart is filled with food high in fat, and sugar and low in nutrients. Co-creation of value inherently requires more than one service system to participate (Vargo et al. 2008). Alternatively, the proximity of a fitness facility may inspire co-creation of health, while no gym and an easy access to fast food may have the opposite effect.

Health creation is recognized as an open system, and an individual's lifestyle as influenced by a broad range of activities, interactions, and exchanges. In order for individuals to achieve desired goals they must perform a broad series of activities (McColl-Kennedy et al. 2012) often involving a network of resources. Resource integration activities within a network are linked to or dependent on one another. For example, even if positive outcomes are co-created in a dyadic relationship within an individual's value creation network, other integrated resources may further boost these outcomes or destroy the created value. Health is also an outcome that cannot be determined as a result of any single service relationship, but is a result of health behavior, genetics, environmental conditions, social circumstances and resource integration (McGinnis et al. 2002).

Three processes have been identified for value co-creation in a service relationship (Storbacka & Nenonen 2009). They are the customer value creating process, the firm value creating process, and the encounter process. Although the original work considered B-2-B relationships, these processes can be seen as equally adaptable to co-creation in B-2-C relationships involving an individual customer as the end user.

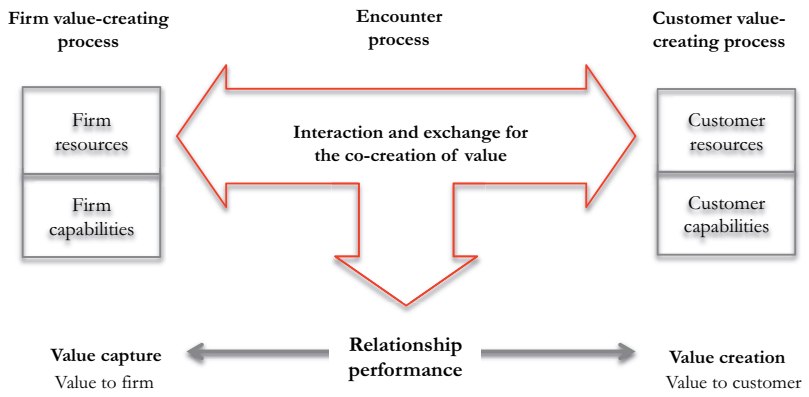

Figure 5: Dyadic co-creation of value (Storbacka and Nenonen 2009)

Figure 5 shows co-creation of value as an interaction and exchange process between a firm's (service provider's) and customer's value creation processes. Capabilities consist of skills and accumulated knowledge that enable coordination of activities and effective resource utilization (Day 1994; Morgan & Hunt 1999). Resources and capabilities of customers and the service providers are integrated to create value and affect relationship performance (Figure 5; Storbacka & Nenonen 2009). They have been presented as heterogeneous to each customer (Storbacka & Nenonen 2009), as was also previously highlighted by the view of health economics and the Capability approach.

Defining an individual customer's capabilities in the context of health and wellness is complex. A further clarification must be made between health as a capability and the capability to achieve health. Health as a capability includes for example, the ability to live to old age or to engage in economic transactions (Sen 1999). In the model presented in Figure 4, capabilities imply inputs for value co-creation. In context of a lifestyle intervention these would be individual capabilities to achieve health, such as a commitment to increasing physical activity. The way that people *actually* function is different from having the *capability to function* in important ways if they so wish. Thus, capabilities can change as a result of a service relationship; such is the goal in lifestyle interventions in the occupational setting.

In the occupational context, lifestyle intervention service typically aims to improve health behavior and increase capabilities to stay healthy and productive at work. It is of managerial importance to understand how well

these different types of service perform in this context. Relationship performance has been defined as "the total value formed during the interaction between firm and customer over time" (Storbacka and Nenonen 2009, p. 362). This definition can be applied directly to the effectiveness in creating health outcomes within a service relationship. However, although health may be changed as a result of an individual relationship (e.g., successful surgery), changes usually occur over a longer time-span (e.g., recovering from a surgery or avoiding diabetes). This is especially the case in lifestyle intervention service relationships that seek to accumulate lasting health behavior changes and subsequently improved health outcomes. Due to the temporal delay of potential changes in health outcomes, it is challenging to measure relationship performance with them. This dissertation will discuss indicators of health status that can be used for determining relationship performance on a shorter term. Indicators can predict the potential health outcomes beyond the duration of the service relationship (see section 2.4).

2.3.4 Customer value creation process

In service research, the concept of a customer has evolved from a recipient of service provided by a producer to someone who participates in creating value in service experiences (Bitner et al. 1997; Prahalad & Ramaswamy 2004a; Prahalad & Ramaswamy 2000) to an actor who creates value (Normann 2001; Grönroos 2008; Vargo & Lusch 2008). Normann (2001) rejected the word *consumer* because "the whole idea of consumption is that of destruction…I prefer to think people as 'creators of values' rather than 'destroyers of values" (Normann 2000, p. 31).

In line with views about the customer, the *patient* concept has developed in healthcare management discourse. Patient originates from Latin word *patior* meaning suffer, bear, or endure. The view of the patient has developed from a suffering provider-dependent individual (Foucault 1973) to a person who is closer to being a customer (Nordgren 2009). Additionally, the view of care seekers has shifted from waiting patients, first to consumers than to customers, who according to service management actively choose health service providers and create value in their own processes (Nordgren 2003).

The 9th foundational premise of S-D logic states that all social and economic actors are resource integrators. Customers do not look for services as such; instead, they seek solutions that serve their own value-generation (Grönroos 2000). When faced with insufficient personal resources, customers draw on the resources of others to create value (Baron & Harris 2008). For the purpose of health creation and maintenance an individual has to make daily choices to integrate favorable resources while avoiding unfavorable ones. Public resources are important determinants of access to service in countries with publicly funded healthcare and legally mandated occupational health service.

Adding to the complexity of health is the fact that customers commonly have multiple health and wellness needs simultaneously. Managing something this complex might be beyond a person's competence and access (Gummesson 2010). Without the focal actor (customer) the value constellations for an individual's health do not exist, since it is the customer who creates value (Grönroos 2006) and integrates resources (Vargo & Lusch 2008) to his process of "lifestyle management". In acquiring service constellations around health creation, each individual acts as a resource integrator. Although the model of a customer as a resource integrator expands across a wide array of health service co-creation (such as serious illnesses, end-of life care etc.), the focus here is on resource integration as it relates to lifestyle management.

In service management the customer concept erases boundaries of production and consumption (Normann 2001, p. 120), which are interlinked by the concept of value co-creation. Similarly, patient empowerment has been an active topic in healthcare management literature for the past decade. Patient empowerment implies that the patient is increasingly in charge of resource integration of his or her own care. Health and wellness service also often requires major customer input and participation in order to achieve good outcomes (Ouschan et al. 2006; Bitner et al. 1997). In lifestyle interventions, "the cure" is very much dependent on an individual's own actions. The boundaries of medical professionals and customers are becoming blurred as a result of these shifts (Nordgren 2008).

Customer levels of health co-creation

The importance of customer participation and self-management has been highlighted in the clinical literature (Michie et al. 2009), behavioral health

(Matarazzo 1980) and health economics (Grossman 1972). Varying levels of customer participation in health service have also been examined in the service literature (Bitner et al. 1997; McColl-Kennedy et al. 2009). The level of customer input in co-creation varies depending on the level of customer involvement and role performance (Bitner et al. 1997; McColl-Kennedy et al. 2009). Bitner et al. (1997) examined customer participation and identified three categories: low (customer presence is required), moderate (customer inputs are required for service creation), and high (customer co-creates the service outcome). They described health-related examples for two of these categories: an annual physical exam requires some inputs from the customer, whereas in personal training or weight reduction program, continuous customer inputs are mandatory for co-creating the required behavior change.

In Figure 6, I have expanded Bitner et al.'s categories (1997) for this dissertation. When in a service relationship with a service provider, an individual becomes a *customer* and is supported by the provider in his or her value creation.

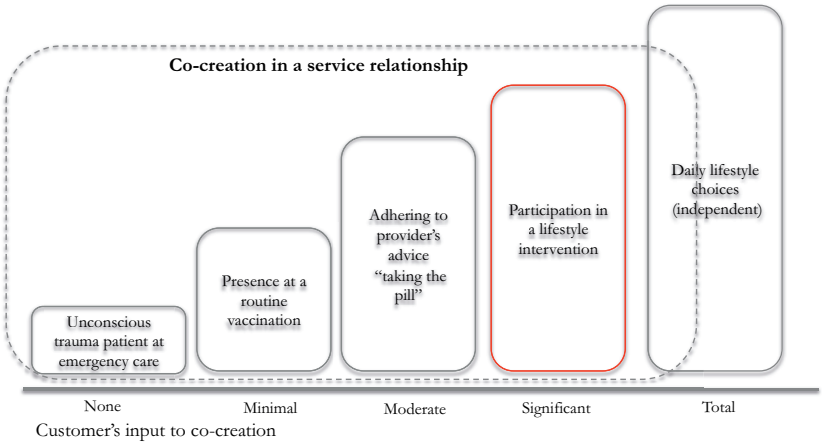

Figure 6: Customer levels of co-creation in health within a service relationship

In the Figure, the *none* level of co-creation includes situations where a patient is present only physically, such as in the case of an unconscious trauma patient in an emergency care unit or a surgical patient under anesthesia. In these cases, a passive patient cannot be considered an operant resource co-creating value, but his health is contributed to by the service provider's actions.

The *minimal* level of co-creation resembles ideas presented by Bitner et al. (1997) and is focused on the presence of the customer. At this level, interaction for co-creation is minimal, and no specific inputs are required from the customer. In a traditional healthcare service, information asymmetry and knowledge gained by formal physician training often force customers to leave care, decision making, risk assessment, medication and procedures to the experts. Individuals are still likely to delegate decision making to the physician in matters of curing an illness or surgical interventions.

When customers engage in *moderate* co-creation, they become operant resources with inputs to co-creation of their own health. Adherence to a medication regime is an example of moderate co-creation.

Lifestyle interventions require *significant* inputs from a customer in order to change health. This behavior is co-created with the support of a service provider. Unless the customer participates in co-creation, the service provider cannot exogenously deliver an outcome. There can be no value without the customer integrating the service provider's offering into their life (Vargo & Lusch 2008).

The author has added a category where an individual co-created health *independently* with his or her existing resources (operant and operand) or by integrating resources of other service providers. This behavior may also be influenced or informed by a previous service relationship where co-creation took place, but there is no active service relationship. Thus, the service relationship overlaps in Figure 6. A prior service may integrate into the customer's ongoing activity beyond the service process (Heinonen et al. 2010). An individual may rather independently create positive health behavior. Heinonen et al. (2010) enforced this view by pointing out that "customers might not be interested in the company's offering: they can often perform all activities themselves, or wish to reduce the role of the company." The last two categories overlap at times. Additionally, given that health is created in a network of resources, provider relationships at their best can only provide partial inputs to the lifetime process of health creation and maintenance.

2.3.5 Provider value creation process

Service providers do not exist to distribute value along a value chain (Storbacka and Nenonen 2009, p. 361); their role is to support customer processes (Day 1994; Normann & Ramirez 1993; Storbacka & Lehtinen 2001; Storbacka & Nenonen 2009; Deshpandé et al. 1993) and to empower people as co-creators (Bendapudi & Leone 2003; Vargo & Lusch 2008). In S-D logic, the service provider's role in value-creation is not as a value *creator* for the customer but as a value *co-creator* (Vargo & Lusch 2008; Vargo et al. 2008; Lusch et al. 2008).

The 7th foundational premise of S-D logic (Table 1) states that a firm cannot deliver value, but can only offer value propositions (Vargo & Lusch 2008). In other words, service providers' activity is "input for the customer's resource integration, value creation activities rather than its own integration of customer resources for the production of valuable output" (Vargo 2008, p.214). It is not the customers who get opportunities to engage themselves in the supplier's process, but rather vice versa (Grönroos 2008).

Lusch and Webster (2011) provided a historical perspective on value proposition and defined it as an invitation to participate in the process of co-creating value that is superior to competitor offerings. It is seen as the provider's suggestion to the customer as to how its resources and capabilities can enable the customer to create value (Storbacka & Nenonen 2009). Value proposition is therefore a process of how a service provider proposes to positively affect the customer; it defines desired outcomes, not outputs. Because of the networked nature of value creation, a value proposition must also allow all stakeholders see the potential value for themselves (Lusch & Webster 2011).

Different types of lifestyle intervention service are sold with inflated value propositions. A growing number of service providers claim to help customers become healthier, change their diets, build muscles, or to run a marathon. Advertisement aimed at employers considering work-place intervention programs promote increased health, decreased sickness absence, decreased use of healthcare resources, and improved employee productivity.

Providers input their capabilities and resources into co-creation of value. In lifestyle intervention service, these include expert knowledge, technology, and

motivational interaction. Although service provision processes vary, interaction for supporting the customer is generally at the core of any lifestyle intervention service. Karpen et al. (2012) recognized provider capabilities that facilitate value co-creation processes and enhance it by including a capability to empower customers to change service outcomes. They noted that little is known about the organizational capabilities necessary to execute S-D logic (Karpen et al. 2012).

2.3.6 Encounter process

Customer relationships have been defined as social and economic processes where value is co-created (Storbacka & Nenonen 2009). They are developed in interactions and dialogs between service providers and customers. In a service relationship, a customer and provider expect to have repeated contact in the future. Over time, they develop a history of shared interaction they can draw on (Gutek 2000). For a lifestyle intervention service it is typical to track the customer's progress (e.g., changes in weight) and health inputs (e.g., daily physical activity), creating a history for the service encounters to draw from.

The line of interaction is referred to as an *encounter process*. An encounter process is two-way interaction and can be initiated by either party (Payne et al. 2008). Service is created in the dynamic interactions (Tronvoll et al. 2011). In the encounter process, the actors use their capabilities in collaborative activities and practices of integration and exchange for co-creation of value (Storbacka and Nenonen 2009). A classic definition of a service encounter is a period of time during which a consumer interacts with a service directly (Shostack 1985). The definition builds on the notion that services are produced, delivered and consumed during an encounter process (Grönroos 1984; Langeard et al. 1981; Zeithaml et al. 1985).

Lifestyle intervention service, however, aims to affect an individual's health related activities beyond the encounter process. Recently, the term *interaction* has been equated to the term *service encounter*. Interaction is central to S-D Logic, where it is seen as the generator of service experience and value-in-use (Ballantyne & Varey 2006).

Service encounter research has focused on interactions between customers and employees of a service company (Fisk et al. 1993). Service has traditionally

been seen as involving interpersonal interactions between customers and service employees, and explored through service encounters or as "moments of truth" (Solomon et al. 1985; Czepiel 1990; Shostack 1985). Shostack's definition does not limit the interaction to customers and providers; in fact, it suggests that service encounters can occur without any human interaction (Bitner et al. 1990). A customer's willingness to engage in the encounter process may vary. There is evidence that customers often fail to optimize their co-creation role (Dellande et al. 2004), even though service providers seek to increase it through active interaction (McColl-Kennedy et al. 2009).

Empowerment of the customer has been the core driver for offering different types of information and communication technology-enabled service in health and wellness contexts (Honka et al. 2011). Examples include eHealth and remote monitoring technologies as platforms for the encounter process (Ahern et al. 2006; Wilson et al. 2004; Hesse & Shneiderman 2007). The role of technology in service has been explored, moving the focus of research from interpersonal interactions to technology-enabled and remote interactions (Bitner et al. 2000; Bitner 2001; Dabholkar 2000; Parasuraman & Colby 2001; Quinn 1996). Technological solutions have recently been recognized as potential engagement platforms for co-creation (Ramaswamy 2011).

Technology can increase the customer's ability to self-deliver service and to create value without explicit involvement of a service provider (Dabholkar 1994; Heinonen 2004). It has been proposed that cost-effectiveness of care delivery could be improved by using information and communication technologies (ICT) to move routine live interaction to more cost-efficient remote and asynchronous channels (Ilvonen 2007). Effectiveness is assumed to increase due to lack of time- and location-constraints of traditional face-to-face encounters (Ilvonen et al. 2009). In lifestyle interventions accelerometry-based activity monitors have become one of the most commonly used methods for remote assessment of physical activity. These small and noninvasive devices provide an objective record of movement (Welk 2002) and provide users with instant feedback on health behavior.

2.4 MEASURING THE EFFECT OF CO-CREATION

In order to build a framework for examining the effect of co-creation on health, the concept of relationship performance is linked to effectiveness. The form of health intervention evaluation that considers the efficacy of a service and its acceptance by those to whom its offered, is the evaluation of effectiveness (Drummond et al. 2005). Relationship performance in the lifestyle intervention context can be seen as implying the effectiveness with which service outcomes are co-created during a service relationship.

2.4.1 Relationship performance and effectiveness

Relationship performance as a measure is interpreted as closely related to the concept of effectiveness. Effectiveness measures whether healthcare resources are being used to get the best value for money (Palmer & Torgerson 1999). Traditional economic approaches to effectiveness interpret various types of service as inputs and "health" as the output. A health outcome is often used as a process outcome measure, but can rarely be mapped to a single input. A lifestyle intervention service can be seen as an intermediate output.

Effectiveness is concerned with the relationship between resource inputs (costs, use of labor, capital, or equipment) and either intermediate outputs (number of people treated) or health outcomes (lives saved, life years gained, quality adjusted life years gained) (Palmer & Torgerson 1999). The most popular measure of efficiency in health economics is the Quality-Adjusted Life Year (QALY). The QALY attempts to value the benefits of health care in terms of a measure that combines the impact on longevity with quality of life into the common numéraire of a year in good health. The number of QALYs relating to a health outcome is expressed as the value given to a particular health state, multiplied by the number of time spent in that state.

Using intermediate outputs can lead to false conclusions about effectiveness that should be measured as health outcomes (Palmer & Torgerson 1999). In measuring a lifestyle intervention's relationship performance, the primary effectiveness measure is the change in health behavior achieved through co-creation. The total value formed during the interaction for co-creation is estimated by linking health behavior change to health outcomes. Health

outcomes can be seen as indicators of an individual's capability to achieve other valued outcomes (Sen 2002).

2.4.2 Health outcomes

Popular managerial discussions on value in health are driven by the writings of Michael Porter and colleagues, and have followed the core ideas of health economics and popularized them further. From the 2006 book (Porter & Teisberg 2006) to their most recent Harvard Business Review article (Kaplan & Porter 2011), their arguments about value in health have evolved closer to the health economics construct of effectiveness. Defining service outputs in the health context is problematic, because health service is rarely demanded for its own sake, but rather for the possible positive contribution to the customer's health status. Thus, health outputs should be defined in terms of the health outcomes produced (Jacobs et al. 2006).

Health outcome, by definition, is a change in the health status of an individual, group or population which is attributable to a planned intervention or series of interventions, regardless of whether the intervention was intended to change health status (WHO 1998). According to Porter (2010), value in health is defined in terms of health outcomes achieved per dollar spent. A powerful driver of value in health is that better outcomes often go hand in hand with lower total care cycle costs (Kaplan & Porter 2011). Therefore, encouraging prevention and early diagnosis may spare costs of care later in a patient's life. This idea resembles the fundamental reasoning for doing lifestyle interventions in the first place: limiting health deterioration also lowers costs by reducing the resources required for care. Value measures should focus on selecting interventions and treatment approaches that improve outcomes while eliminating service that does not (Kaplan & Porter 2011).

Porter and colleagues have drawn parallels between health outcomes and value (Porter & Teisberg 2004; Porter & Teisberg 2006; Porter 2010). According to Porter "value, neither an abstract ideal nor code word for cost reduction, should define the framework" (2010, p.2477) for effectiveness measurement in health. Health outcome as a measure is inherently patient-centered, because it describes the patient's actual changes in health. Health outcomes provide a numéraire of value that has shared relevance to all stakeholders (Porter 2010).

In measuring health outcomes, value is defined as the customer's health, not the provider's inputs or process measures of delivering care. More care does not always imply better care and focus should be on value rather than volume (Porter & Teisberg 2006).

When health outcomes are contrasted to the resources invested into achieving them, comparisons of different programs, interventions, and processes are enabled. Thus, effectiveness is encompassed in the value definition when value is defined as outcomes relative to costs. Investments into new service without regard to the outcomes achieved by them can lead to false potential of value capture and misalignment of scarce resources. Health outcomes have been seen to indicate the 'value-added' to health as a result of contact with the health service system (Jacobs et al. 2006).

Measuring health outcomes implies identifying the context, measuring health status before an intervention, measuring the intervention, measuring health status again and then relating the possible change in health outcomes to the intervention (Porter 2010; Kaplan & Porter 2011). To examine potential health outcomes on a shorter term, different indicators can be used to predict health outcomes (Figure 7).

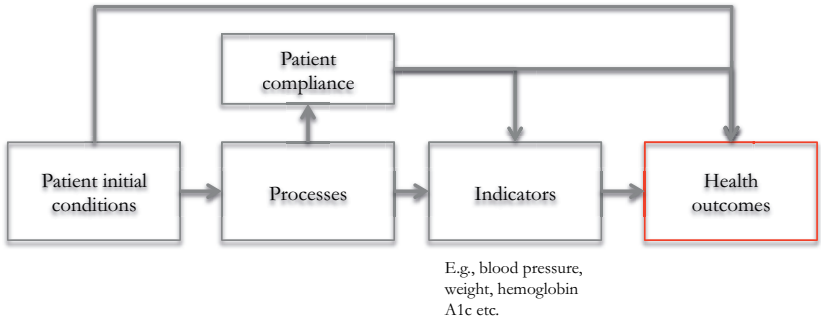

Figure 7: Measuring value in health care (Porter 2010)

The figure shows that individuals enter service processes with an initial health status. This status reflects the heterogeneous resources and capabilities for performing value-creating activities, and it can affect the encounter process and its success. Health status at this point is defined by a description or measurement of an individual's health against identifiable standards, usually by

reference to health indicators (e.g. current weight). Porter interlinks the initial patient status to health outcomes.

The second step is the service process, such as a lifestyle intervention, surgery, or a disease management program. This process is modeled as health indicators (surrogate markers, risk indicators) that are physiological measures predicting health outcomes. Using indicators is advantageous because of their relatively straightforward early measurability compared to outcomes, which in most cases can be observed only over time.

In Porter's model, customer compliance is the final component affecting health outcomes (2010). The success of health service in changing health outcomes depends on an individual's compliance with a provider's instructions or care guidelines (Dellande et al. 2004). Medication compliance is a notorious example: adherence is typically around 50%. Compliance is even lower for lifestyle prescriptions and other behaviorally demanding regimens (Haynes 2002). Although compliance implies customer action in response to guidelines given by the service provider, it is here seen as co-production rather than interaction for co-creation of value.

Health empowers people with capabilities to achieve other goals in their lives. An individual's capability to work productively and stay healthy can also affect his employer and other people in his life.

Focusing on service outcomes in the context of health and wellness has been encouraged by recent service literature (Ostrom et al. 2010). For example, a recent review for research priorities also called for considering a customer's activity in improving his well-being through service (Ostrom et al. 2010).

2.5 RESEARCH GAPS AND MODELING CO-CREATION OF HEALTH

In order to examine the effect of co-creation of health three conceptual models were extended to account for particular characteristics of co-creation in the lifestyle intervention context. The models combine service research, health economics and measurement of value in health. The models seek to contribute to the identified gaps in the current literature and to build a foundation for examining the phenomenon of interest empirically.

2.5.1 Research gaps relating to co-creating health

In summarizing the literature, the following research gaps were identified:

1. Limited research exists on co-creation in the health context
2. The theoretical discussion of co-creation needs to account for particular characteristics of the health context;
3. Health-context-specific characteristics of co-creation have not been conceptually modeled;
4. There is a lack of quantitative research linking the effect of co-creation and service outcomes, especially in the health and work productivity context.

First, service research has recognized healthcare as an area where co-created outcomes are necessary (Berry & Bendapudi 2007; Bitner et al. 1997). Health as an application area has received limited attention in service research, even though specific calls for research have been made (Berry & Bendapudi 2007; Bitner et al. 1997). Although the customer's role in co-creation of health has been recognized in previous research (Bitner et al. 1997; Ouschan et al. 2006; McColl-Kennedy et al. 2009), limited empirical research exists on the subject. Relationship performance has not been discussed in the health service context and the effect of co-creation on health outcomes in lifestyle intervention service remains unexplored. Current service research literature regarding health is largely conceptual.

On a more general note, in the literature the concept of co-creation is insufficiently defined to enable quantitative empirical examinations. There is a lack of consistency in defining the nature of co-creation and how to measure its effects. Previous research has demonstrated limited operationalization of co-creation in empirical research.

Second, health as an application area for service research has context-specific characteristics of co-creation that have not been fully covered by research. The literature review highlighted an increasing need for information on co-creating health, given that the factors that compromise health have changed dramatically in the last decades. Co-creation through different types of lifestyle intervention service is a potential way to diminish unfavorable health behavior

and remedy the epidemiological crisis of increasing lifestyle-related diseases. Current research has not addressed the capability of co-creation processes to increase health as a service outcome. The effect of co-creation has not been linked to measures of relationship performance in the health context. Another largely unexamined area relates to interactions and their effects on customer co-creation activities, such as health behavior. Lifestyle interventions with daily health behavior monitoring offer an opportunity to examine the effects of interaction for co-creation of health; this idea will be further discussed in section 3.1.

Third, health as a context has several specific characteristics of co-creation that have not been comprehensively modeled. These characteristics include but are not limited to health as co-created value, value of health as a capability, health behavior's role in co-creation, cumulative nature of health outcomes and the fundamental importance of third party (payer) involvement. These specific characteristics have received limited attention in service research. Current conceptual models of value creation of health do not comprehensively explain the importance of customer health behavior on creating health, and thus neglect co-creation.

Finally, while much has been done to advance conceptual understanding of value co-creation, research is still in an early stage. It has largely overlooked construct development and lacks empirical testing (Zhang & Chen 2008). There are also no quantitative empirical studies on co-creation of health. No applications have been made to examine relationship performance or effectiveness of a health service on changing outcomes through co-creation. There is also a knowledge gap in what customer's "do" when co-creating (Payne et al. 2008). Health behavior has been raised as an example of customer action in co-creation by Bitner et al. (1997), but its relationship to service outcomes has not been empirically examined. The relationship performance of lifestyle interventions on changing health behavior as a service outcome has not been addressed in conjunction with co-creation of value. While the above remains true for service research, other disciplines have discussed lifestyle interventions more systematically. Thus, the phenomenon is approached by combining other streams of literature that have examined lifestyle interventions empirically to service research.

2.5.2 Modeling co-creation of health

From exogenously produced value to co-creation of health

Building on the identified gaps in the literature, the following extended model explains how co-creation of health differs from the goods-dominant view on healthcare service production discussed in subsection 2.2.1. This model builds on the Grossman model (1972) of Demand for Health (see Figure 2). Grossman's original work concentrated on the utility derived from health service and other commodities. He modeled service provider output exogenously, entering an individual's utility process (implying that the product or service has value as such), therefore reflecting goods-dominant logic. The production process was a multiproduct environment accounting for all service providers involved with an individual's health. The original model neglected co-creation of health between the service provider and the customer.

The original Grossman model was extended to account for the process of interaction and exchange for co-creation of value (Figure 8). It is presented as a dyad, but the provider process can be seen as co-produced or a multiproduct environment, as in the original Grossman model. Instead of a production process, the model presents a provider value creation process, which highlights the service approach. The customer's process is modified from a utility function to a customer value-creating process and modeled as specific to an individual.

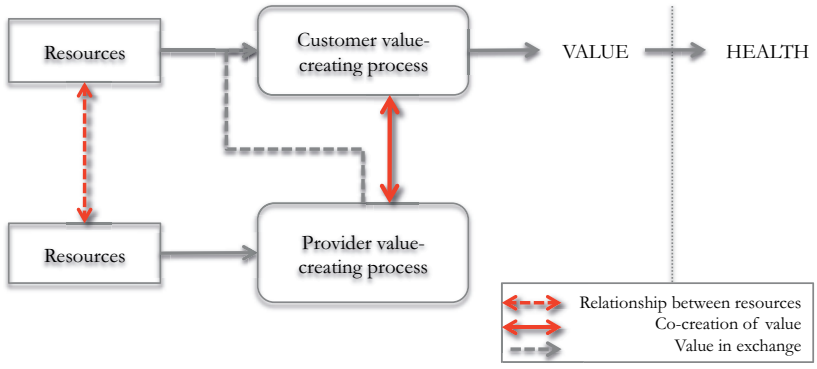

Figure 8: Model of co-creating health (modified from Grossman 1972)

Figure 8 shows the customer and the provider integrating resources for value-creation. The figure mimics Grossman's input vectors and reflects the idea of resource integration of S-D logic. The integrated resources can be seen as a mix of operant and operand resources. In a lifestyle intervention, integrated provider resources may include personnel time, expertize and specific technology. Customer resources may include time, motivation, and exercise gear. Furthermore, although this dissertation focuses on interaction for co-creation, exchanged value is not excluded from the model. Value is assumed to be exchanged and co-created (Brodie et al. 2006; Penaloza & Venkatesh 2006).

The dashed red relationship in the figure indicates a relationship between the resources integrated to respective value creation processes. Resources implemented, or not implemented by one party, may affect the resources implemented by the other. Consider, for example, an individual who exercises regularly, eats a healthy diet rich in vegetables, is a non-smoker and watches out for potholes in the pavement. Daily behavioral choices affect health in the long term. This behavior may decrease an individual's need for health care provider resources. This interconnectivity between the customer's and provider's resources may not be planned for or intentional as with co-creation within service relationship, but it affects the resource integration needs of both parties.

The solid red arrow in Figure 8 illustrates co-creation within a service relationship. This relationship indicates encounter processes that require input from both parties for co-creation. They include processes and practices of interaction and exchange for co-creation of health outcomes. An example of this relationship is a lifestyle intervention. Here, the provider and the customer agree to work together (co-create) in order to achieve a change in the customer's health behavior. The encounter process might consist of interaction related to goal setting, motivation, progress, feedback etc. depending the service model.

A grey dotted line connecting the customer and provider indicates an exchange between them. The exchange may be a service encounter that does not require co-creation or a physical good. Much like in the original Grossman model, this relationship can be seen as representing value-in-exchange.

This extended model recognizes that health outcomes may not represent value as such. Value may be observed from multiple perspectives or different

stakeholders. It may be understood as a holistic and experienced-based phenomenon, which is not related to a single output or event (Vargo and Lusch 2008). An individual may prioritize other functionings, experiences, outcomes, or capabilities over measurable changes in health indicators, and therefore, health and value must be distinguished.

Third parties in co-creation

Co-creation of value has been primarily modeled as a dyadic relationship in service research (section 2.3.3). In public health and occupational health contexts, there is strong third party involvement in the form of funders (public health funding, employer or insurance). Employer investments into employee health are expected to accumulate a return on investment (this will be further discussed in Chapter 3).

The model presented here extends Storbacka and Nenonen's co-creation of value model (2009) to explicitly model third parties in a co-creation. Third party value capture has been added to the model to describe investment in service and the potential direct and indirect value capture from increased health and productivity. In an occupational lifestyle intervention, the primary health co-creation relationship is between a service provider and an end-user (employee), but a third party (employer) has a central role in enabling the service. Third party value capture in creating health outcomes has received limited attention in the literature. Recently, lifestyle intervention studies in this context have increasingly included measures of value capture to the third party payer. These work-related measures may be able to justify investments into this type of service. For an employer, as a third party, typical measures include increased productivity, reduced sickness absence, reduced use of healthcare resources, reduced employee turnover etc. The employer also seeks to capture value from the investment; therefore, the original model is extended from B-2-B (Figure 9).

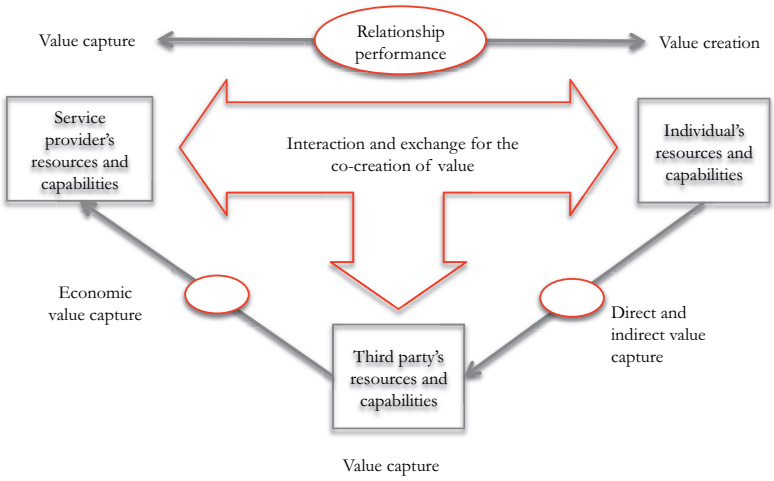

Figure 9: Interaction for co-creation in occupational lifestyle interventions (Modified from Storbacka and Nenonen 2009)

Figure 9 models resources and capabilities of all three parties in the interaction for co-creation of health outcomes. Resource performance involves interaction and exchange for co-creation between all three parties. Resource performance reflects standard microeconomics in that it compares inputs to captured value. All three parties integrate resources and capabilities into the co-creation, but the value creation and value capture logics differ among them. Relationship performance has been extended to account for performance between the third party and the service provider (economic value capture), as well as between the third party and the individual customer (direct and indirect value capture from increased health).

Service provider value capture is often straightforward in lifestyle interventions. The provider is compensated for services rendered based on the number of participating individuals and the duration of the service. Compensation is rarely, if ever, tied to outcomes. In occupational settings, employers typically pay for the service and employees get them for free.

Customer input to value creation is modeled as the amount of interaction initiated and extent of health behavior changes. As noted, customer value capture can take various measures. Here, customer value is operationalized as changes in health status indicators that predict possible changes in health outcomes (Figure 10) and capability. An example of practical

operationalization of co-creation of health is given in the empirical examination of this dissertation.

Measuring the effect of co-creation

In order to empirically examine the effects of a lifestyle intervention on health, the measuring value in health model (Figure 7) presented by Porter (2010) was extended to account for health behavior change. Several additions and correctives are proposed here in order to apply this model to analysis of lifestyle interventions.

Porter (2010) presented a causality chain beginning with a patient's initial condition. Figure 10 shows how this idea has been adapted to health status. Not all individuals participating in lifestyle interventions are 'patients' and they do not necessarily suffer from a medical condition. The health status concept is used to highlight the functional and metabolic efficiency of the individual as more positive measures.

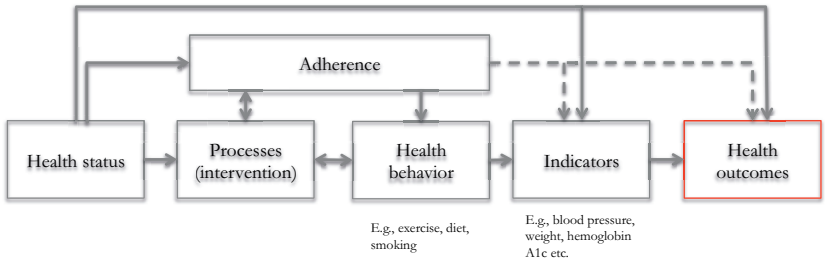

Figure 10: Measuring co-created health outcomes (Extended from Porter 2010)

In the original model, the process had a one-way effect on health indicators. Here, the intervention process has a two-way relationship with health behavior (Figure 10). Not only does the intervention process aim to influence health behavior, but the service process may also be influenced by an individual's behavior.

The health behavior aspect of health creation was not accounted for in the original Porter model, which focused on clinical service processes. Health behavior and individual co-creation affect most health related processes (e.g, adherence to medication, following dietary guidelines, fasting before surgery).

Lifestyle intervention service processes specifically aim at improving an individual's health behavior. For example, physical activity is a health behavior that can be quantified and therefore can serve as a measure of the extent to which an individual adheres to physical activity goals set for the service relationship. Sufficient health behavior can affect a variety of health indicators, such as surrogate markers, risk markers, physiological measures, and psychological measures. An improvement in these indicators may predict improved health outcomes accumulating over time, if all other health-related factors remain the same. An improved indicator, however, does not guarantee better health.

In the original model, compliance describes the degree to which a patient correctly follows treatment guidelines and medication. Compliance is "the act or process of complying to a desire, demand, proposal, or regimen" (Merriam-Webster 2012). The term implies that an individual is an object of care, instead of a subject making choices regarding his care. Thus, adherence, "the act, action, or quality of adhering"(Merriam-Webster 2012) was chosen as a more illustrative term to describe an individual's participation. Adherence to goals and guidelines is linked to better health indicators (e.g., lower cholesterol and weight) and in the long term to better health outcomes on an aggregate level.

The capabilities approach was presented in the literature review to explain why it is important to measure health outcomes, not outputs or perceptions of the service. Having added the health behavior component and further explained the causalities between the different steps of creating health, the extended model builds a framework for the empirical analysis.

CHAPTER 3

PHYSICAL ACTIVITY, HEALTH AND PRODUCTIVITY IN THE LITERATURE

This chapter presents a brief narrative review of the literature on the empirical context of this dissertation. The theoretical assumptions on lifestyle interventions on physical activity leading to health outcomes and subsequently increased productivity are presented. Then physical activity is linked to health outcomes and value capture for the employer. Finally, health behavior's effect on work productivity is discussed.

"It seems plausible that a healthier nation or a corporation might have to spend less on healthcare" (Baicker et al. 2010).

Employer organizations commonly encapsulate productivity problems as unperformed work. Work that does not get done due to sickness absence or lowered work productivity incurs costs that have to be paid although the worker doesn't contribute to the provider's value creation process. Sickness absences, lowered capability and subsequent lowered productivity while at work, occupational accidents, and premature retirements all accumulate economic costs that could be avoided if the person was healthy and at work. Many employers therefore often implement lifestyle interventions in order to keep people at work and capable of performing their jobs.

An increasing number of employers associate poor health with reduced employee performance (Goetzel & Ozminkowski 2008). The organizational costs of poor health and behavioral risk factors include high medical, disability, and workers compensation expenses, elevated absenteeism and employee turnover, and decreased productivity while at work. Employers hope that health intervention programs will improve employee health, reduce risk for disease, decrease healthcare utilization, limit sickness absence, and decrease health related productivity losses while at work. In other words, employers aim at improving employee capability to work productively. Effective lifestyle interventions have potential benefits for the employee (direct health benefits) and benefits for the employer (direct and indirect benefits from employee health). Lifestyle interventions may also have early benefits attributable to enhanced corporate image and worker satisfaction rather than to improved health per se (Shephard 1992). These benefits tend to diminish as programs continue.

Workplace health promotion interventions can be put into three categories: a) awareness programs, b) supportive environment programs and c) lifestyle programs (O'Donnell et al. 2002; Pencak 1991). Workplace health promotion has generally focused on promoting employee health by reducing risk behaviors (Quintiliani et al. 2007). Interventions in the work place can be integrated into broader efforts to support employee health (DeJoy & Southern 1993), such as occupational health and safety initiatives and disability management programs (Williams & Westmorland 2002). Lifestyle interventions are measures taken to prevent diseases rather than curing them or treating their symptoms. Conventionally, different levels of prevention are called primary, secondary and tertiary (Table 4).

Table 4: Levels of prevention (U.S. National Library of Medicine 2012)

- **Primary prevention** includes the specific practices for the prevention of disease or mental disorders in susceptible individuals or populations
- **Secondary prevention** is the prevention of recurrences or exacerbations of a disease that already has been diagnosed.
- **Tertiary prevention** includes measures aimed at providing appropriate supportive and rehabilitative services to minimize morbidity and maximize quality of life after a long-term disease or injury is present.

Lifestyle intervention programs support primary, secondary and tertiary efforts (Goetzel & Ozminkowski 2008). Primary prevention in the occupational setting is directed at generally healthy populations. These programs are concerned with preventing disease and reducing exposure to environmental and behavioral risk factors (Tones & Green 2008). Primary prevention programs offer opportunities for workers who do not maintain good health and who may fall prey to preventable diseases[10]. Secondary prevention efforts are directed at individuals already at identified risk because of certain lifestyle practices (e.g., smoking, being sedentary, having poor nutrition and consuming excess amounts of alcohol). These efforts focus on early diagnosis-for example, by screening-to improve the prospects of treatment (Tones & Green 2008). Tertiary programs promote better compliance with medication and adherence to evidence-based guidelines for outpatient management. These efforts include measures to reduce the consequences of illness and are often seen as integral to rehabilitation programs (Tones & Green 2008).

[10] Empirical research in this dissertation is focused on primary prevention efforts in focusing on programs targeted for the entire staff, instead of risk groups or selected segments of employees.

The theory that lifestyle interventions in the work place lead to cost-savings for the employer depends on the following assumptions (Proper & van Mechelen 2008):

1. The lifestyle intervention leads to improved health behavior (e.g., physical activity);
2. Improved health behavior is positively linked to health outcomes, and thereby leads to reduced healthcare costs; and
3. Improved health behavior is directly or indirectly (through improved health outcomes) related to productivity and thereby leads to cost savings for the employer.

These assumptions are still largely theoretical since they are primarily based on associations made in observational studies. They are however widely used as grounds for implementing lifestyle intervention programs in the occupational setting.

In the following, the discussion on co-creating health outcomes through lifestyle interventions (underlying logic and previous research) is presented following the structure of these three theoretical assumptions on value creation in lifestyle interventions. The literature supporting each of the assumptions was identified through specific searches of research on occupational lifestyle interventions. Examples of previous lifestyle intervention studies targeting physical activity in similar context with RCT methodology were reviewed. These studies were identified by searches of PubMed and Google Scholar databases. Non-peer-reviewed, non-English and studies published before 1990 were excluded from the review. Further selection was done based on eliminating studies with research bias. The literature presented in this chapter is not an exhaustive systematic review of intervention studies, but highlights the inconclusive evidence of lifestyle intervention effects in the occupational settings.

3.1 THE IMPACT OF LIFESTYLE INTERVENTIONS ON PHYSICAL ACTIVITY

Studies examining physical activity interventions and health outcomes have become increasingly popular since the 1990s. Physical activity has been facilitated through the use of various behavioral strategies that encourage sedentary or inadequately active individuals to reduce sedentary behavior and to achieve or surpass minimum public health guidelines for physical activity. These studies have been conceptualized and operationalized in different ways, such as increasing light and moderate intensity activities, increasing leisure time activities, or decreasing sedentary activity (Dunn et al. 1998).

3.1.1 Previous studies on physical activity interventions

Most of the studies done in the nineties did not have a significant effect partly explained by the fact that they were done on small groups of individuals in various clinical settings (e.g., Andersen et al. 1997; Dunn et al. 1997; Dunn et al. 1998; Proper & van Mechelen 2008). Since then increasingly rigorous methods and larger samples have been used to study this phenomenon in real-life settings. Yet, these strategies have repeatedly failed to solve physical inactivity among healthy working populations (Proper & Van Mechelen 2008).

Most intervention studies claiming a significant change in physical activity have been non-randomized prospective studies with small self-selected populations (e.g. Aldana et al. 1993; Aldana et al. 2005; Bertera 1990; Gibbs et al. 1985; Ozminkowski et al. 1999; Ozminkowski et al. 2000). A selection bias may arise when allocation methods other than randomization are used. In non-randomized settings, the intervention and the control groups are unlikely to be comparable (Van Dongen et al. 2011). Non-randomized studies of healthcare interventions have generally been found to result in larger estimates of effect compared to RCTs (Kunz et al. 2007). Previous studies have concluded that baseline differences in group characteristics and baseline confounders (e.g., motivation to change health behavior) are likely to cause bias, when allocation is not controlled for (Linden 2011).

Table 5: Examples of previous RCTs on effectiveness of physical activity interventions in the occupational setting

Author(s)	Intervention (I = intervention group, C: control group)	Sample (I = intervention group, C: control group)	Results summary
Speck & Looney (2001)	I: Physical activity monitoring (pedometer) during 12 weeks, daily records of PA, C: pedometer	Working women, I:24, C:25	Difference in pedometer values (200 steps/day = 1 mile).
Proper et al. (2003)	I: Seven 20 minute consultations over a 9 month period on PA and healthy diet promotion, C: no intervention	Civil servants, I:131, C:168	Positive effects on energy expenditure, PA during sports, body fat % etc.
Slootmaker et al. (2009a)	I: Physical activity monitoring (accelometer) for 3 months, C: no intervention	Young office workers I:48, C:50	No significant intervention effect was observed at 3 or 8 months follow-up.
Groeneveld et al. (2010)	I: Motivational interviews face-2-face and over telephone, C: no intervention	Males at risk for cardiovascular disease I:376, C:408	Weight reduction and significant intervention effect on diastolic blood pressure.
Van Wier et al. (2009)	I1: Material and phone counseling I2: Web intervention and email counseling, C: No intervention	Overweight employees I1: 462, I2: 464, C: 460	I1 and I2 were found effective for reducing body weight at 6 months.
Aittasalo et al. (2012)	I: 1 group meeting, log-monitored pedometer and 6 emails from occupational healthcare, C: no intervention	Office-employees from 20 worksites I:123, C: 118	Modest impact on some indicators of walking

Table 5 presents examples of randomized controlled trials targeting physical activity in the occupational setting. Their results can be summarized as, 1) "the

majority of previous RCTs in occupational settings have been illness-related, or the focus has been on highly selected groups of employees" (Taimela et al. 2008, p. 240), and 2) at best, the effects have been modest irrespective of statistical significance.

Recent reviews of worksite physical activity interventions have been conducted by Abraham and Graham-Rowe (2009) and Conn et al. (2009). Abraham and Graham-Rowe concluded that occupational interventions have small effects on physical activity when using self-reporting and more modest effects when using objective measures of cardiorespiratory fitness, such as the VO_2 max test. Conn et al. evaluated over 200 studies and concluded that the studies had similarly small effects on physical activity. Both reviews assessed the impact of moderating variables, such as intervention techniques and contextual characteristics.

Lifestyle interventions generally include many components. Based on meta-analyses of systematic reviews, lifestyle interventions typically produce small effects with large heterogeneity on effectiveness (Michie et al. 2009). There remains limited knowledge on which components or combinations of techniques are most effective for primary and secondary prevention of inactivity in adults. Physical activity interventions including self-monitoring and at least one of four other self-regulatory techniques have been found in a meta-regression of randomized studies to be slightly more effective than interventions not including these techniques (Michie et al. 2009). The potentially effective self-regulatory techniques were identified as: intention formation, specific goal setting, feedback on performance, and review of behavioral goals. Michie et al. (2009) concluded that set behavioral targets and many design characteristics such as duration, person delivering the intervention, setting, use of multiple sessions, time to follow-up, or target population did not distinguish between effective and ineffective physical activity interventions.

3.1.2 Use of technology to facilitate interaction in physical activity interventions

As in service research's definitions of co-creation, interaction is emphasized as the value creating mechanism in much of the literature discussing lifestyle

interventions. Interaction for co-creation in lifestyle intervention service can be facilitated through face-to-face meetings, distance counseling or self-service systems. Often, interaction is supported by reporting or monitoring technology enabling the interaction to build on shared history of the individual's health behavior.

Previous studies encourage use of physical activity monitors in lifestyle interventions (Hultquist et al. 2005; Trost et al. 2005; Richardson et al. 2007; Chan et al. 2004). This recommendation is based on the assumption that pedometers, accelometers and GPS devices may help sedentary participants set goals and motivate them to increase physical activity. Rooney et al. (2003) noted that the most significant benefit of wearing a pedometer may not be its ability to monitor the actual amount of activity in any given day, but rather to provide immediate feedback. For example, seeing a count of physical activity from an accelerometer has been hypothesized as inspiring the individual to move more (Bravata et al. 2007). As discussed previously, ICT is often used to boost effectiveness of care delivery, but monitoring health behavior technology also enables real-time motivation and encouragement.

The same technology used in the empirical research of this dissertation has been used in one other RCT. A trial involving Dutch office workers (Slootmaker et al. 2009a) was conducted at roughly at the same time as CoAct. The results of that study were not published at the time of CoAct's design. The study population consisted of 102 healthy office employees between 23 to 39 years old. The physical activity intervention was 3 months long, with daily activity monitoring and Internet counseling. The control group received a single written information brochure with brief general PA recommendations. No significant intervention effect was observed on awareness of physical activity, level of actual physical activity, aerobic fitness, or body composition among a group of young healthy employees.

3.2 ASSOCIATIONS BETWEEN PHYSICAL ACTIVITY AND HEALTH OUTCOMES

The benefits of physical activity depend on regularity, duration, and intensity (Ainsworth et al. 1993). Various public health guidelines have been published

on the recommended volume and intensity of physical activity for healthy adults. The American Heart Association, the US Surgeon General, the Centers for Disease Control and Prevention and the American College of Sports Medicine recommend at least 30 minutes of at least moderate intensity physical activity on most days of the week (Pate et al. 1995; Haskell et al. 2007; Fletcher et al. 1996). In order to enhance health outcomes through physical activity, an individual should be active 5 days a week for 30 minutes at a time. To maintain health, a minimum of 30 minutes of physical activity 3 times a week is recommended (Haskell et al. 2007).

The metabolic equivalent unit (MET) is a commonly used measure for sufficiency of physical activity. MET expresses the energy cost of physical activities as multiples of resting metabolic rate (Byrne et al. 2005) (see Section 4.4 for details). A range of 500 to 1,000 MET-minutes of activity per week has been found to provide substantial health benefits in older adults, and amounts of activity above that have even more benefit (Nelson et al. 2007). Nelson et al. present the dose-response relationship to continue even within the range, in that the health benefits of 1,000 MET-minutes per week are greater than those of 500 MET-minutes per week.

However, 40% of the global population remains sedentary (Bauman et al. 2009) and is unable to derive benefits from physical activity. As seen in Figure 11, 39% of Europeans say they never engage in sport or exercise.[11] Exercise accounts for all planned, structured and repetitive physical activity with the objective to improve or maintain physical fitness (Caspersen et al. 1985). Sport is competition-oriented physical activity.

[11] Exercise is a form of leisure time physical activity that is usually performed repeatedly over an extended period of time with a specific external objective such as improvement of fitness, physical performance, or health.

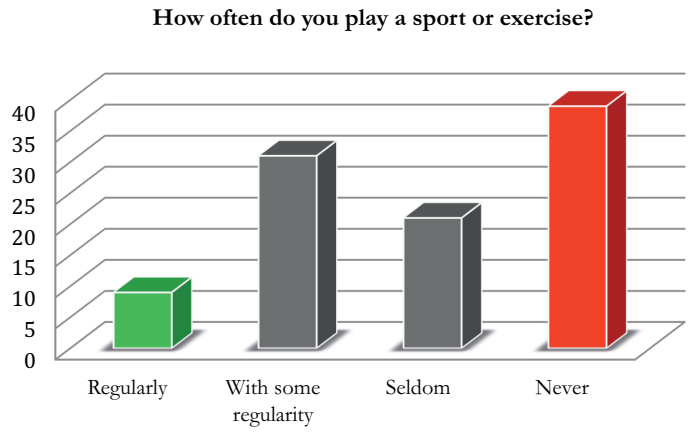

Figure 11: Survey results on frequency of physical activity (Special Eurobarometer, 2010)

In the most recent Eurobarometer survey (2010) on physical activity and exercise, the Nordic countries were found to exercise most actively. In Finland, 72% of people reported they exercised 'regularly' or with 'some regularity', clearly exceeding the EU average of 40%. A clear majority (65%) of Europeans get some form of physical activity (yard work, walking the dog etc.) at least once a week. However, the alarming finding in the survey was that 14% of EU citizens are completely inactive, saying that they never do any physical activity, and another 20% report that they seldom do any physical activity. The prevalence of insufficiently active people is much higher than people who smoke, have high blood pressure, or have high blood cholesterol.

Regular physical activity has beneficial effects on health, and consequently, on preventing a broad range of health disorders and diseases (The World Health Organization 2003). Physical inactivity has been recognized as one of the major modifiable lifestyle-related risk factors for cardiovascular disease, along with smoking, high blood pressure, and elevated blood cholesterol (Pate et al. 1995). In numerous studies, physical activity and exercise have positive effects on many risk factors for cardiovascular and metabolic diseases, such as blood pressure (Martin et al. 1990; Arroll & Beaglehole 1992; Cooper et al. 2000; Whelton et al. 2002; Staffileno et al. 2007; Blair et al. 1984), overweight and obesity (Shaw et al. 2006; Wing 1999; McTigue et al. 2003), insulin sensitivity (Borghouts & Keizer 2000), diabetes (Sigal et al. 2006; Laaksonen et al. 2005; Wadén et al. 2008), osteoporosis (Vuori 2001), depression (Brosse et al. 2002),

breast cancer (Friedenreich et al. 2010; Lynch et al. 2011), colon cancer (Slattery & Potter 2002), and coronary artery disease (Powell et al. 1987; Morris et al. 1990; Blair et al. 1989). The greatest potential for reduced mortality has been found in sedentary people who become moderately active (Blair et al. 1995). An increase in physical activity, together with a healthy diet, has the greatest potential to reduce the incidence of chronic disease (Proper & van Mechelen 2008). Despite current efforts to encourage people into increasing physical activity, "physical inactivity remains a pressing public health issue" (Haskell et al. 2007, p.1082). The key question remains how to effectively promote physical activity in an increasingly sedentary population.

3.3 PHYSICAL ACTIVITY AND WORK PRODUCTIVITY

Physical activity has been widely hypothesized to increase an individual's capability to perform productively at work. Healthier employees are expected to be more productive and miss fewer days of work (Goetzel & Ozminkowski 2008). The relationship between health and productivity is complex (Koopmanschap et al. 2005). Loss of employee productivity is "a combination of loss of time at work (absenteeism) due to illness and time at work with reduced levels of productivity while at work (also known as presenteeism)" (Aronsson & Gustafsson 2005; Aronsson et al. 2000; Burton et al. 2004; Koopman et al. 2002; Schultz & Edington 2007, Beaton et al. 2009). Yet employers have traditionally focused on their large and easily measured cost of health care, and have, until recently, ignored the impact of health on productivity (Schultz & Edington 2007). This may be largely because, though potentially being the primary cost driver due to ill health, productivity and work performance have proven difficult to measure (Riedel et al. 2001).

3.3.1 Physical activity interventions and sickness absences

Sickness absence days are costly for the employer, though short-term and long-term sickness absences also predict early retirement and have significant financial consequences (Taimela et al. 2008). Sickness absence as a proxy

measure of productivity is seen as representing potential value capture from the lifestyle intervention programs to the employer.

Previous prospective studies have demonstrated that those who are physically active are at reduced risk of sickness absence (Jacobson & Aldana 2001; Eriksen & Bruusgaard 2002; Van den Heuvel et al. 2005; Proper et al. 2006; van Amelsvoort et al. 2006; Jans et al. 2007; Christensen et al. 2007; Holtermann et al. 2011; Strijk et al. 2011). Some of these studies show only a relatively weak relationship between physical activity and sickness absence (Eriksen & Bruusgaard 2002; van Amelsvoort et al. 2006) and the association between physical activity and absenteeism is yet ambiguous at best (Aldana et al. 2005; Proper et al. 2002; Aldana & Pronk 2001).

The relationship between behavioral health risks and worker absenteeism was investigated in a prospective study conducted by Serxner et al. (2001). Data on absenteeism and on 10 behavioral health risk areas were collected from over 35,000 employees. The authors examined whether higher health risks are associated with higher absenteeism, and whether a reduction in health risks would translate into a reduction in absenteeism. They found a significant relationship between health risks and absenteeism in 8 of 10 risk areas examined. They concluded that individuals at high risk are more likely to be absent than individuals at low risk and that individuals who reduce their risks are absent less often than others. The authors, based on the findings of this observational study, suggest that absenteeism and the costs associated with it may be controlled by health promotion programs and the reduction of health risks (Serxner et al. 2001). However, proof from randomized intervention trials is needed to support this claim.

Proper et al. (2006) examined the dose response between sickness absence and physical activity from large Dutch databases. They found no relation between moderate physical activity and sick leave. They did find that physical activity at a vigorous intensity level for at least three times a week, as in the ACSM recommendation, has a positive effect on sickness absences. However, it is to be noted that only rather healthy people are able to move repetitively at vigorous intensity.

Most of the intervention studies, regarding the effect of physical activity on work-related outcomes have examined the association between physical

activity and absenteeism (Heaney & Goetzel 1997; Aldana & Pronk 2001; S. Van den Heuvel et al. 2005). There are few intervention studies that could have demonstrated a change in physical activity and associated this change with reduced sickness-related absence or increased productivity. Systematic reviews of randomized trials in this context provide little evidence on any approach being more effective than other in effecting sickness absences.

3.3.2 Physical activity interventions and productivity

Previous research on the effectiveness of worksite physical activity programs on work-related outcomes has found unsatisfactory results, poor methodological quality and lack of randomized studies (Proper et al. 2002). The evidence remains inconclusive or non-existent for a positive effect of physical activity interventions on productivity at work and. There also remains a lack of randomized controlled trials evaluating lifestyle interventions in the occupational setting with productivity outcomes (Proper & van Mechelen 2008).

Reviews of health promotion and intervention programs have reported a link between employee health and productivity, implying an adverse relationship between acute and chronic disease and work performance (Riedel et al. 2001; Burton et al. 1999). Prior research has also indicated that risky employee behaviors are associated with costs (Pronk et al. 1999), and that reducing these behaviors is associated with decreased healthcare costs (Riedel et al. 2001).

A recent systematic review on financial return of occupational health interventions was able to identify only 4 RCTs measuring productivity outcomes (Van Dongen et al. 2011). Furthermore, the review concluded that whereas non-randomized studies show positive financial returns, RCTs have not demonstrated that the interventions could pay for themselves in terms of improved productivity. Non-randomized studies may be biased toward a positive effect and showed overly positive financial return in a recent review (Van Dongen et al. 2011). All RCTs in the review (Groeneveld et al. 2011; Meenan et al. 2010; Proper, De Bruyne, et al. 2004; Baker et al. 2008) yielded a negative financial return.

Research has primarily used self-reported data to estimate decreases in productivity (e.g. Osterhaus et al. 1992; Lerner et al. 2002; Brouwer et al. 1999;

Hagberg et al. 2002). Objective measures of productivity at work are rarely available or are difficult to access (Meerding et al. 2005). A profusion of self-reported productivity measurement instruments have been developed (e.g. Lerner et al. 2001; Kessler et al. 2003; Goetzel et al. 2003; Koopman et al. 2002; Van Roijen et al. 1996; Endicott & Nee 1997; Lerner et al. 2001; Brouwer et al. 1999). Several reviews examining one instrument's advantages over another exist (Lofland et al. 2004; Prasad et al. 2004; Ricci et al. 2001; Allen & Bunn 2003a, b; Ozminkowski et al. 2004; Koopmanschap et al. 2005). Self-reported productivity as quantity and quality of work (with the QQ instrument) have been found to correlate with objective work output (Meerding et al. 2005). The QQ instrument was thus selected for measuring productivity at work in the empirical examination of the current study (see Chapter 4.4). Productivity at work has also been examined in previous literature on intervention effects through measuring quantity and quality of work done before and after intervention (Brouwer et al. 1999).

The costs attributed to employee health problems are usually measured in terms of direct healthcare costs, such as occupational health costs. Although it has been understood that employee health problems also produce indirect costs for employers, their measurement has been far less frequent (Burton et al. 1999). Most studies tempting to capture the indirect costs are characterized by small, selected samples and non-randomized populations (Van Dongen et al. 2011).

3.4 USE OF BEHAVIORAL THEORY IN PROMOTING HEALTH BEHAVIOR CHANGE

Recent literature has increased its focus on the use of behavioral theories and psychology in designing lifestyle interventions. At the forefront of the literature is the application of behavioral theory in designing the interventions (Rhodes & Pfaeffli 2010). Behavior change techniques are specific strategies used in interventions to promote behavior change (Webb et al. 2010). Worksite interventions on physical activity have used techniques such as barrier identification, goal setting and self-monitoring (Napolitano et al. 2003). Lack of a taxonomy for reporting intervention components and their effects has made

it difficult to identify the specific characteristics that are the most effective in promoting behavior change (Taylor et al. 2012; Abraham & Michie 2008).

Research published prior to the year 2009 did not examine the extent to which theory was used to inform the design of interventions, and how this fact affects their effectiveness (Taylor et al. 2012). Webb et al. (2010) conducted a meta-analysis of internet-based health promotion interventions assessing the impact of theoretical basis on effectiveness. They concluded that interventions designed with extensive use of theory tend to report larger effects on behavior than interventions with no theoretical base. The review indicated that use of behavioral theory, especially theory of planned behavior, in designing health behavior interventions, could be associated with increases in effect sizes. The interventions with the largest effect in the review were secondary prevention efforts and targeted high risk populations (Hurling et al. 2007; Carr et al. 2008). Recent research examining the use of theory-based components by Rhodes & Pfaeffli (2010) and Michie et al. (2009) identified changes in self-regulation constructs to possibly have the most effect on changes in physical activity. Honka et al. (2011) concluded that there is no single theory to date that would predict and explain health behaviors and that multiple theories and disciplines are needed to design effective interventions.

A meta-analysis of the impact of theory on effectiveness examining exactly the same research context as this dissertation was recently published (Taylor et al. 2012). The analysis examined whether a) interventions explicitly designed based on theory are more effective, and b) inclusion of specific behavior change techniques improves effectiveness. The review examined 27 studies; most were randomized controlled trials. Results indicated that such interventions produce small overall effect sizes. Subgroup analysis indicated that interventions using behavior change theory more explicitly were slightly more effective, producing a larger effect size than studies without explicit use of theory. Studies that used a larger number behavior change techniques were not found increasingly effective.

3.5 RESEARCH GAPS RELATING TO THE EMPIRICAL CONTEXT

The logic of lifestyle intervention service creating value is based on the idea that interaction for co-creation supports the customer in changing health behavior, and subsequently, health outcomes. Service supports a customer during a health maintenance episode by providing such things as goal setting, feedback, and encouragement. There is a lack of solid research documenting the effectiveness of physical activity interventions on changing health behavior in the occupational context.

The following research gaps were identified:

1. The majority of research on occupational lifestyle interventions on physical activity lacks the methodological rigor required to make conclusions about effectiveness;
2. There is a lack of work-related outcomes;
3. There is a lack of research combining theories and approaches;
4. Explorative analysis on interaction's effectiveness on co-creation activity has not been applied.

First, many studies in the occupational context suffer from methodological limitations, including inadequate sample sizes, selective participation, use of non-randomized designs, use of inadequate outcome measures, and lack of objective measures (Quintiliani et al. 2007). Previous studies have not been able to draw undisputable conclusions about the impact of work place interventions, and there remains a lack of methodologically sound randomized trials investigating the effectiveness of lifestyle interventions, such as on physical activity and subsequently work related outcomes in the occupational context (Proper & van Mechelen 2008). Two prior reviews (Dishman et al. 1998; Proper et al. 2003) have supported this idea in reporting that the methodological quality of the published literature is weak due to poor study design, and outcomes being measured solely by self-reporting. Even the evidence that occupational physical activity interventions can affect on physical activity remains inconclusive. As such, data supporting worksite programs is not definitive and evidence on that these interventions can change physical activity behavior of primarily healthy adults remains limited.

Second, previous research has presented a limited discussion on how much interventions affect an individual's capability to function in at work. Lifestyle intervention effects on work-related outcomes of sickness absence and productivity have received limited attention in previous research. There remains a gap in research on examining productivity while at work.

Third, studies examining the effectiveness of lifestyle intervention programs are rarely linked to other discourses. Managerial implications of value capture from investments into lifestyle intervention service have received limited attention. While return-on-investment of lifestyle interventions to the employer have been examined by a number of cost-effectiveness studies no model for value co-creation in this context has been presented. To the authors best knowledge no generally accepted model of value capture has been published for this context. Therefore, studies reporting return for the employer use different methods, different measures, and report their findings incommensurably (Van Dongen et al. 2011). Recent research has encouraged use of psychology and behavioral theory in designing interventions. Indications that theory-based interventions would be more effective have been published in recent reviews (e.g., Taylor et al. 2012; Webb et al. 2010; Michie et al. 2009). This approach has mostly emerged in literature after the empirical research in this dissertation was designed. The examined intervention service is however based on components that have been found effective in health psychology research. Furthermore, the difference in effectiveness between theory-based and non-theory based physical activity interventions is small based on the meta-analysis of systematic reviews (Taylor et al. 2012).

Finally, the differences in effects of different types of service encounters within a service relationship have received limited attention in lifestyle intervention studies (Marcus et al. 2006). My literature review was not able to identify any explorative studies where the immediate or short term effects of interaction on health behavior were analyzed. The difference in effectiveness between different types of service encounters and interactions to nudge behavior change has not been highlighted in the literature. Although interaction is hypothesized in most intervention models as the driver for health behavior change, it has received limited attention in research, and there remains a gap in examining interaction's short-term effects on health behavior.

CHAPTER 4

RESEARCH APPROACH AND METHODOLOGY

This chapter presents the research approach where a classic randomized controlled trial is expanded with realist approach in order to explore co-creation in the lifestyle intervention service context. Methodological choices, used instruments, data collection and validity and reliability are discussed.

4.1 THE REALIST APPROACH

The current study incorporates a novel approach to a phenomenon traditionally explored largely from positivist standpoints of clinical research. In addition, it is also based on on realist ontological and epistemological positions, aiming to discuss the complex nature of value co-creation. Scientific activity would not be possible just by making positivistic claims, because most events take place in open systems, where events do not invariably follow a determined pattern (Harré & Madden 1975; Bhaskar 2008), but are subject to diverse causal variations (Tsoukas 1989). According to Tsoukas (1989) it is precisely because of the open character of the world that research needs to engage in experiments in which conditions resembling closed systems are constructed in order to identify causality.

In this dissertation, a pragmatic RCT methodology was employed to develop gold-standard evidence concerning the effectiveness of a physical activity intervention service. The positivist analysis is supported also with a realist approach and service research knowledge in order to model and discuss co-creation phenomenon in a pragmatic and managerially significant way. Realism

is the view that scientific theories correctly describe the nature of a mind-independent world. Outside the philosophy, realism is usually regarded as common sense, but philosophers enjoy subjecting this "common sense" to the scrutiny of the realist approach (Chakravartty 2007).

4.1.1 Realist view on knowledge

Realist ontology assumes reality to be ultimately objective and holds that it is possible to acquire knowledge about the external world independently of subjectivity. In the realist view, knowledge is shaped by data, evidence and rational considerations. Knowledge is a cumulative process in which new insights add to the existing knowledge pool. Realism can be understood through three dimensions: ontological, semantic and epistemological (Chakravartty 2011).

Ontologically realism is committed to scientific investigation of the world independently from human perceptions. Reality can be perceived with limited certainty and precision due to the researcher's limited capability to observe reality and due to the complexity of phenomena observed (Tsang & Kwan 1999; Pawson & Tilley 1997; Ackroyd & Fleetwood 2000).

Semantically, realism is committed to a literal interpretation of scientific claims about the world. Realists seek to construe scientific statements as true or false. Furthermore, to be called knowledge, a belief must not only be correct, but also must be justified (Hunt 2003). Knowledge changes over time and is a cumulative process in which new insights are added to the existing knowledge pool. Along these lines, the research described here relies on extensive medical literature (health management, epidemiology, behavioral science) to explain health behavior and its effects on health outcomes, and contributes to knowledge on lifestyle interventions in the occupational setting and service research.

Epistemologically, realism is committed to the idea that theoretical claims constitute knowledge of the world (Boyd et al. 1991). Realists see that the best scientific theories to give true or approximately true descriptions of observable and unobservable aspects of the mind-independent world (Chakravartty 2007). Research can only reach the empirical domain of reality, implying that our knowledge of the world is always partial (Tsoukas 1989). In the empirical

exploration of this study, the researched problems reflect the need to identify and assess the causes that influence outcomes. A realistic epistemological position is suitable for this study, since most aspects of the observed phenomenon are objective.

Realist evaluation is theory-driven, in testing out the underlying program theories (Chakravartty 2011). Often core theories based upon which programs are designed to change or affect behavior or outcome are evaluated for the purpose of refining them. Realist evaluation doesn't ask *What works?* or *Does this program work?*, but rather *What works for whom in what circumstances and how*? (Pawson & Tilley 1997). Interventions are always inserted into existing social systems and are therefore parts of open systems. Changes in patterns of behavior, events or conditions are generated by inputs to these systems in the hope of disturbing and re-balancing them.

To summarize Pawson and Tilley (1997), the realist research perspective begins with a theory of causal explanation based on generative principles. It supposes that underlying mechanisms constituted by people's reasoning and their resources in a particular context bring about regularities in social activity patterns. The task of research is to identify if and how outcomes are generated by specific mechanisms and to make comparisons in order to see which context-mechanism-outcome configurations are effective. Knowledge that accumulates over successive trials and other empirical research provides policy makers material for decision-making.

4.2 RESEARCH DESIGN

The number of intervention studies in the occupational setting has grown in recent years as lifestyle programs and interventions have become increasingly common. Occupational intervention studies evaluate the effects of planned activities at the worksite or within the work context, with the aim of improving working conditions and/or the health of workers (Kristensen 2005).

An intervention study was chosen for examining co-creation effects because of the following benefits: a) these studies are usually considered to be more conclusive regarding causality than observational studies, b) if intervention studies are successful, the results are usually more convincing than

observational research and may provide justification for investment in these programs beyond the initial case company, c) intervention research necessitates a close collaboration between the researcher and the company enabling mutual learning.

A quantitative strategy for inquiry was selected to contribute to understanding co-creation effects in the physical activity intervention context. In a quantitative strategy, variables play a central role. A variable refers to a characteristic or attribute of an individual or organization that can be measured or observed and that varies among the ones studied. Variables are distinguished by temporal order and their measurement. Temporal order means that one variable precedes another in time and therefore probably causes another. It is a challenge to prove causality, cause and effect, in natural settings involving humans (Rosenthal & Rosnow 2008).

4.2.1 Randomized Controlled Trial

This study examines the effect of co-creation within a lifestyle intervention on physical activity and subsequently on sickness absence and work productivity. In order to analyze physical activity as an independent variable and its effect on health outcomes, a pragmatic randomized controlled trial design was chosen as the method. RCT's are quantitative, comparative and controlled experiments (Robson 2003) that are used in order to examine an intervention's effect on outcomes. For a while, evidence-based medicine was interpreted by many authors as advocating a view that "only evidence worth its name in medicine is that supported by properly controlled randomized trial" (Worrall 2010). RCTs still set the methodological standard of excellence in effectiveness research and the method chosen because of its rigorous nature.

The RCT is a particular variant of true experimentation involving the use of a control group. In essence, it is a study in which subjects are allocated at random to receive one or more clinical interventions (Stolberg et al. 2004; Robson 2003). On most occasions, intervention refers to treatment, but the term can be used in a wider sense, including any maneuvers that may have an effect on a subject's health. One of the interventions is always the standard of comparison, or the control.

The randomization procedure gives the RCT its strength. If randimization succeeds, the treatment arms are fully comparable at the start of the trial and the potential differences between them after the intervention are attributable to it and not to some unidentified factor (Rawlins 2008). RCTs have a prospective design, meaning that at least one measurement is done before the intervention and at least one afterward, enabling assessment of changes over time. By definition, "the effect is the difference between what happened in the intervention group and what would have happened without the intervention" (Kristensen 2005, p.2).

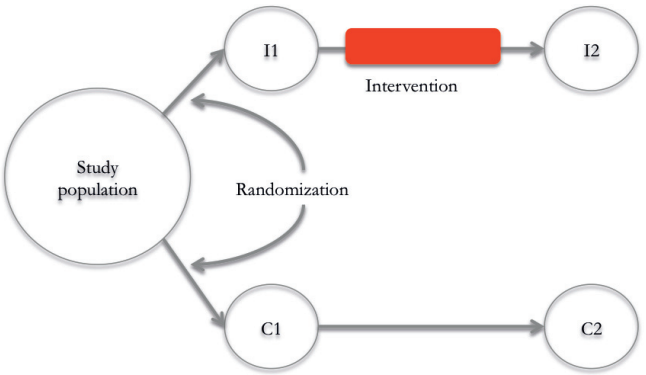

Figure 12: Model of the Randomized Controlled Trial

An RCT design was chosen because of three major advantages of proper implementation of randomization. First, it eliminates bias in the treatment assignment. Second, it facilitates blinding of the identity of treatments from the researcher, participants, and assessors. Finally it permits the use of statistics to express likelihood that any difference in outcome between treatment groups indicates change (Schulz & Grimes 2002).

"The argument for choosing an RCT as a design is that they provide the best evidence for effectiveness, for whether something works" (Robson 2003, p.116). If successful, an RCT provides far more convincing results than observational or non-randomized studies (Van Dongen et al. 2011; Kristensen 2005). Although uncommon in service research, the RCT has been as the method of choice for evidence-based-medicine.

The choice faced in designing a study to address 'real world' problems is either to describe outcomes of people treated in completely natural settings without

use of randomization (observational studies) or to adapt the traditional RCT to retain its key advantages and emphasize external validity (Hotopf 2002). The risk of not comparing like with like always exists in non-randomized evaluations. Thus, the key advantage of randomization is that it rules out confounding factors. Provided that enough subjects are randomized, the two groups will be similar in most aspects. Pragmatic trials are designed to examine how effective an intervention or treatment actually is in routine, everyday practice. Pragmatic trials primarily answer questions of an intervention's overall effectiveness and are not well suited to study the contributions of its different components (MacPherson 2004).

The appropriateness of positivist RCT design to social research has been discussed (Robson 2003). Critiques of RCTs claim that they fail to capture complex social phenomena of real world settings. First, the interventions, approaches, and procedures researched by RCTs commonly have little or no effect as compared to the outcomes in non-controlled studies. Second, the design or implementation of an RCT is often challenging and subject to technical problems. For example sample sizes are often insufficient for generalizing results. RCT methodology has been claimed unrealistically isolate the studied intervention from the larger context surrounding the studied phenomenon. The method does little or nothing to explain why an intervention has failed or succeeded (Robson 2003).

The realist approach of establishing "what works, for whom and in what context" (Robson 2003, p. 120) is a way to expand research explorations beyond trial outcomes. Pawson and Tilley (1997) discussed the problem of using RCTs in social research and suggested using sub-group analysis. With a large research population, it becomes feasible to establish contrasts between sub-groups, illustrating and substantiating the differential effects of mechanisms on different sub-groups (Robson 2003, p.121). Sub-group analyses were used in this study to examine effects in subgroups and to explore the interaction's effects within the intervention group according to the actual participation. This study examined pre- and post-measures as well as short-term effectiveness of the service encounters in the intervention group.

4.2.2 Reporting a Randomized Controlled Trial

The reporting of randomized clinical trials is done according to the guidelines of the CONSORT statement (Plint et al. 2006; Schulz et al. 2010). The statement includes reporting a trial's design, conduct, analysis, interpretation, and the validity of its results. It emphasizes that comparability and generalizability of results can only be achieved through complete transparency. This study follows the latest CONSORT guidelines (Schulz et al. 2010).

4.3 EMPIRICAL CONTEXT – THE CO-CREATING ACTIVITY STUDY

The case company was a Finnish insurance company, Pohjola Insurance. The company provides private customers and corporate and institutional customers with a range of insurance solutions. Its employees are primarily based in the Helsinki area and are office workers. The company had selected a commercially available lifestyle intervention service to be implemented for its entire staff and wished to examine the effects of the intervention on health and work related outcomes. The researcher had no input to the selection, content, or implementation of the intervention service. The company funded the intervention service as part of its occupational health initiatives. Its interest was primarily in increasing health and well-being of its employees. Secondarily, the company wanted to explore potential value capture resulting from increased capability: direct benefits of health, decreased sickness absence and increased productivity at work. The researcher was in charge of designing the research approach and the study protocol. The aim of the intervention was to increase physical activity during leisure and commute times. The intervention was implemented as close to as it would have been without the research component.

Beyond reasons highlighted in the literature review, this setting is of interest because in Finland, more than a third of working population engages in less physical activity than is recommended for health maintenance (Fogelholm et al. 2007, Husu et al 2011).

The empirical research was designed as an RCT called CoAct (Co-Creating Activity). This chapter is based on the published protocol article and presents the research design to the extent relevant for the scope of this dissertation (Reijonsaari et al. 2009). The CoAct study was conducted over a 12-month period during 2009-2010 and evaluated the effectiveness of a physical activity intervention with daily monitoring and distance counseling. This study received an ethics review board approval from the Coordinating Ethics Committee (Helsinki University Hospital) in August 2009.

4.3.1 Participants and inclusion criteria

In pragmatic trials, the participants need to be representative of the wider population, so that results can be generalized. Thus, wide inclusion criteria are typically used (MacPherson 2004).

At the beginning of the CoAct study, all of the 1,116 employees of Pohjola Insurance in the Helsinki area were invited to participate in the study with an invitational email. They received a screening questionnaire link to a health risk appraisal (Taimela et al. 2007). If employees reported problems with future work ability, pain, impairment, due to musculoskeletal problems, insomnia or insufficient sleep, frequent stress or fatigue, or had a high depression score, obesity, excess use of alcohol, or a high score for diabetes risk, they were rated as having health problems and directed to an occupational healthcare check-up. After authorization of an occupational physician, the employees with health problems were able to participate in the study. Some employees were not authorized to take part in the trial by a physician and they were thus excluded.

The intervention provider also required each participant to fill out a questionnaire concerning medical history and medication before physical testing. Employees could be excluded before or during physical testing for various medical reasons, such as pregnancy, diagnosis or treatment of cancer, or any disorder prohibiting physical activity (see appendix 3 for medical exclusion criteria). Medical risk appraisal is important for ensuring that participating in the intervention is safe for participants. Individuals with serious medical conditions should go through lifestyle intervention programs only with

physician guidance. The health risk appraisal and the fitness test were done as part of normal occupational health care (Figure 13).

After completing physical testing, employees were invited to take part in the randomized controlled trial. Inclusion criteria for the RCT were: 1) age 18 years or older, 2) paid employment of at least 8 hours a week, 3) not scheduled to retire in the next two years or have applied for disability pension and 4) completion of the health risk appraisal and physical testing prior to randomization. All employees meeting these criteria were asked to individually sign an informed consent form that allowed uploading of their personal data (health risk appraisal, physical testing, occupational healthcare utilization, sickness absence records) to the research database and used in the research. All employees had access to the Internet and were skilled in using it as using computers and the Internet were part of their daily work.

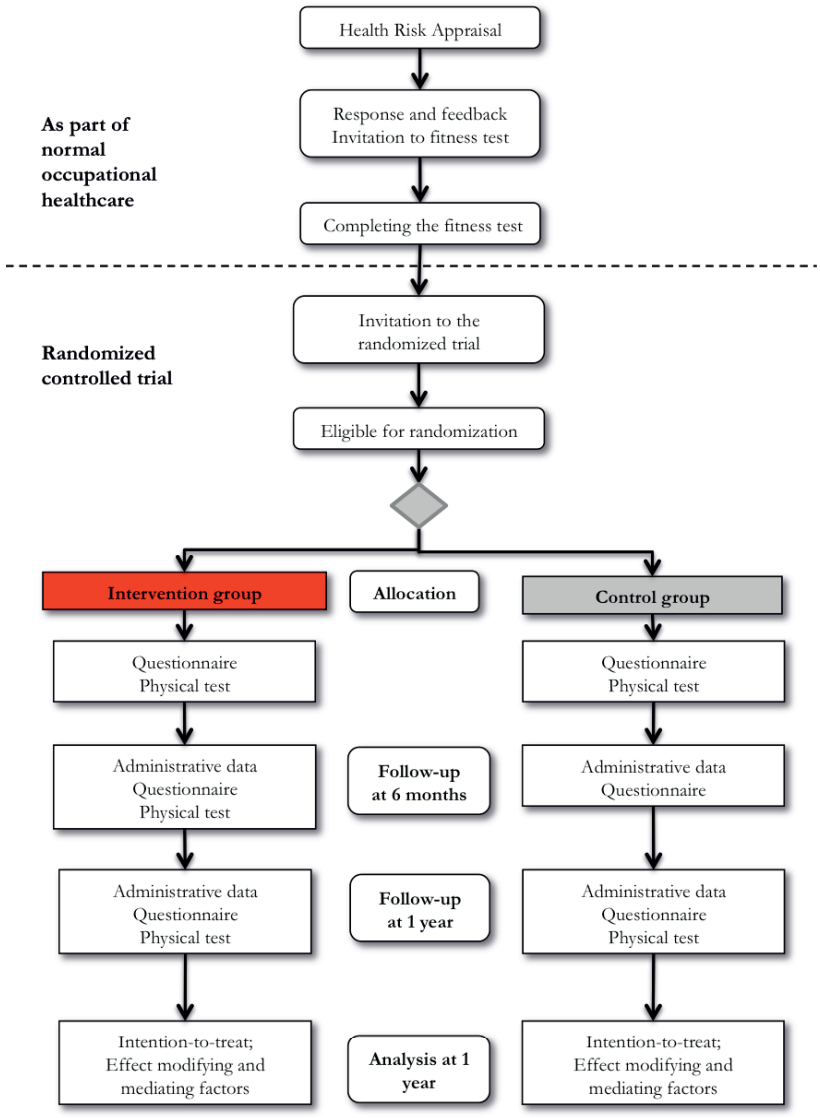

Figure 13: Study design (based on Reijonsaari et al. 2009).

4.3.2 Randomization and blinding

Randomization took place at an individual level, and subjects were allocated 1:1 into two parallel groups (Figure 13). A biostatistician prepared the randomization scheme by using a computer-generated randomization table. Block randomization with blocks of ten was applied. Block randomization is a process that ensures balance in a clinical trial after the enrollment of each *block*

of patients (Doig & Simpson 2005). After every block the number of participants in each group should be equal. Based on the randomization scheme, two research assistants prepared sealed and numbered envelopes before the start of the study. Each contained a referral to the intervention group or to the control group. These envelopes were handed out to the participants after the baseline fitness test by the author and another researcher. After signing the informed consent form, each employee opened a sealed envelope in the given order. The participants or researchers involved were not able to identify the group assignments before randomization. Due to the nature of the interventions, the participants and researchers were not blinded to group assignment after randomization. Participants were not allowed to change groups after randomization. Sickness absence data were extracted from employer records automatically in electronic format and a different research assistant did computer entry of self-reported data, blinding data entry. Allocation was no longer blinded during data analysis.

4.3.3 Control group

Employees randomized to the control group received the results of their physical test in writing and general information about physical activity, but no lifestyle intervention service. They were invited to participate in physical testing again at 12 months and received the Co-Act study questionnaires (primary outcome measures) at 6 months and at 12 months. While pragmatic trials may also be blinded, this is not always possible (Roland & Torgerson 1998). Here allocation could not be blinded do to visibility of the accelerometers to other employees and social communication between the employees.

4.3.4 Intervention group

Employees assigned to the intervention group received their test results and general information on physical activity. They also received a physical activity monitor (PAM, model AM 200, PAM BV, the Netherlands), which is a uni-axial accelerometer in the vertical direction that can be easily attached to a belt. Employees in the intervention group were directed to wear the accelerometer

daily, at work as well as on leisure. The device is not waterproof, so it cannot be used to track activities in water, such as swimming.

For self-monitoring purposes, the monitoring device produces a single index score that accumulates during the day and is a proxy measure of total daily physical activity. The monitor shows a physical activity score continuously on its display that the participant can use as an indicator for reaching his daily goal of physical activity. The validity of the PAM accelerometer in measuring physical activity has been confirmed (Slootmaker et al. 2009b)[12].

The participants had to install PAM software on their computers in order to use the service. Via a USB cable a user can upload his or her personal physical activity scores from the monitor to the service provider's website (http://www.ainoactive.fi) at any time throughout the day. During the first visit, users register on the provider's website by creating a username and password. Upon entry to the website, users were shown a goal score for the 12 month intervention episode. The score were based on mutual goal setting discussion with the service provider.

The service encounters between individuals and the service provider consisted of a meeting at the beginning of the study and follow-up via online messaging and phone calls. At the first meeting, a specific physical activity goal for the 12 months was set based on feedback on performance in the physical test and a review of behavioral goals. Employees were able to determine a comfortable level for the physical activity goal for themselves.

On a day-to-day basis, employees received instant feedback on their physical activity performance from the device. They were able to see feedback on trends in their physical activity by logging onto the online service. On the service provider's website, participating employees could interactively plan and evaluate their own activity advice based on their PAM scores and their physical activity goals and preferences. The value of different types of physical activity in reaching the goal was individually determined as employees were able to plan for the type, frequency, duration and intensity of their physical activity.

[12] The validity of the PAM accelerometer has been tested in a laboratory setting and has shown results similar to the MTI actigraph for estimating energy expenditure in walking and stair walking (Slootmaker et al. 2009b).

The user and service provider could together decide to change a goal score throughout the intervention process. On every login, the service provider's website presented all the uploaded physical activity scores and coupled goals in visual graphs per week or month. Participant could also manually enter physical activity if they had been unable to use the monitor (swimming etc.) or had forgotten to wear it. In doing so they entered the sport, duration and estimated intensity.

The online service enables two-way secure messaging that was used for interaction between the employees and the coaches (Table 6). These interactions were used from the provider's side to motivate, encourage, follow-up and to inform the employees. The employees could freely request advice via online messaging. If an employee did not log on to the site every two weeks to upload physical activity data, he was to receive a phone call from a coach encouraging him to use the service.

The employees in the intervention group also participated in an additional physical test at 6 months into the intervention process. The physical tests were service encounters where the employee and the service provider meet face to face. Occupational health care was continued as usual.

Table 6: Technology used in the intervention

Technology	Enabled interaction
PAM, Model AM 200 accelerometer (PAM BV Netherlands)	Continuous tracking of physical activity. The device produces a single index score that accumulates during the day and is shown on its display. Data is uploaded to the online service.
Aino Active's online service	Customized online service where employees can view their goals, progress and information on physical activity and health. Enables two-way secure messaging.
Telephone calls and emails	Two-way interaction between the coach and the employee. A coach provided encouragement, help and information. The employees could freely enquire about health and physical activity.

4.4 DATA AND DATA COLLECTION INSTRUMENTS

Various instruments and methods were used for collecting data during the 12-month service process. The same instruments were used to define the initial health status as well as health status after the intervention. Instruments for self-reporting physical activity (IPAQ) and work productivity (QQ) were included in the CoAct-questionnaire, which was repeated at baseline, 6 months and 12 months.

IPAQ -Physical activity

The volume (frequency, intensity and duration) of physical activity was assessed by a self-administered questionnaire based on the International Physical Activity Questionnaire (IPAQ). IPAQ questionnaire has two versions; short and long. The self-report short form is a seven-item measure of four domains of activity: vigorous-intensity PA (defined as activities that make you breathe much harder than normal), moderate-intensity PA (defined as activities that make you breathe somewhat harder than normal), walking and sitting (see appendix 1). For each activity domain, examples are provided to indicate that participants are to report activities of work, leisure-time, house and garden work, and transportation. Participants reported frequency (days during the last 7 days) and duration (minutes/hours usually spent on one of those days) of their vigorous-intensity PA (VPA), moderate-intensity PA (MPA), and walking. Only sessions of activity lasting at least 10 minutes were to be reported. Participants also reported the total time spent sitting on weekdays, during the last 7 days. The sitting question was an additional indicator variable of time spent in sedentary activity. It was not included as part of any summary score of physical activity, as there are few data on sedentary behaviors and no well-accepted thresholds for data presented as categorical levels (IPAQ Research Committee 2005).

The short version including three questions on PA was used in CoAct questionnaire (Appendix 1). The total MET (metabolic equivalent)[13] score

[13] The value equating one MET is derived from resting consumption of O2 (Vo2) of a person. In terms of energy expenditure, MET is also defined as the ratio of work metabolic rate to a standard RMR of 1.0 kcal (4.184 kJ)·kg^{-1}·h^{-1}. Physical activities have been described in a compendium by Ainsworth et al. (1993) as multiples of this standard resting energy value (1 MET), ranging from sleeping (0.9 MET) to running at 17.4 km/h (18 METs).

MET min-per-week (continuous score from the IPAQ scoring protocol) was calculated as follows: (daily minutes of walking x days per week with walking x 3,3) + (daily minutes of moderate-intensity activity x days per week with moderate intensity activity x 4,0) + (daily minutes of vigorous activity x days per week with vigorous activity x 8,0) (Ainsworth et al. 1993).

MET values are derived from the IPAQ validity and reliability study (Craig et al. 2003). In addition, truncated MET-minutes per week were calculated, in which all daily minutes exceeding 120 min were truncated to 120 min. This rule has been proposed in the "Guidelines of Data Processing and Analysis of IPAQ Short Version" with the attempt to normalize skewed population data. IPAQ guidelines were followed in processing and cleaning answers, except the recommendation to exclude missing data, as multiple imputation of missing data was used.

Sample size calculation

The size of the expected intervention effect is the main determinant of the sample size required to conduct a successful RCT[14]. The sample size calculation was carried out by a biostatistician and was based on the following assumptions. The standard deviation for the IPAQ score in our population was estimated to be 1500 MET min-per-week. A difference of 400 MET min-per-week between treatment arms was estimated to be detectable with 85% power in two-tailed tests with an alpha of 0.05 for a sample of 253 employees in each group; the standardized effect size was estimated at 0.27. 400 MET minutes equals 100 minutes of moderate intensity (4 MET) exercise per week, i.e., 20 minutes of moderate exercise 5 times a week.

QQ - Work productivity

Work productivity was measured with the **QQ instrument** (Brouwer et al. 1999). The QQ method was developed in an attempt to more precisely measure the consequences of illness while working (Brouwer et al. 1999). The instrument consists of two questions. In the first question, respondents are

[14] The sample size required to achieve power in a study is inversely proportional to treatment effect squared (Rosner 2010).

asked to indicate on a visual analogue scale (VAS) from 1 to 10 the quantity of work they performed during regular hours compared with normal (Appendix 2). This question concerns output rather than productivity, indicating how much work had to be made up for during overtime or regular worktime, or was lost. Translating the answer into costs has the possibility of overestimating true costs involved if it is possible to make up for lost work during regular hours. Fluctuations in daily performance levels are explicit in this method. In the second question, the quality of the work performed is indicated on a VAS scale from 1 to 10 (Brouwer et al. 1999; Meerding et al. 2005). In order to calculate a QQ score, scores from quantity and quality scales were multiplied resulting in scores on a scale from 0 to 100.

Sickness absence

Sickness absence data were obtained without medical diagnosis codes from the employer's payroll records. Each employee was required to inform the company when sick for one to three days and required to provide a sickness certificate when absent for longer than three days. Participants with long rehabilitation periods were excluded from the analysis. Absence days from work to care for a sick child were not included in the sickness absence analysis.

Sickness absence was operationalized as the accumulated number of sickness absence days, excluding weekends. The baseline covered the 12-month period prior to randomization and the follow-up covered the 12-month period after randomization, individually. Data privacy was strictly followed. Records were checked for inconsistencies.

Secondary outcome measures

In response to the discussion on defining health (Chapter 1.1.1), health is operationalized as measurable physical attributes. Physiological indicators predicting future health outcomes were measured as secondary outcomes. These measures are changes in body weight, waist circumference, body fat percentage, blood pressure and aerobic fitness (VO_2 Max). The indicators were measured during the fitness test at baseline and at 12 months for both groups and at 6 months for the intervention group. Details of these measurements and used instruments were published in the study protocol (Reijonsaari et al. 2009).

Accelerometer data

Accelerometer data was continuously captured by the service provider's online system. All data uploaded by participating employees was stored and retrieved for analysis after the intervention period. The data was stored as activity points, which together with information on each participant, can be converted to MET-minutes.

Encounter data

Time stamps from each of the online service encounters as well as telephone calls were recorded in the service provider's database. Although brief summaries of the phone calls and entire content of the messages were stored, they were not used in the analysis. The information on the types of service encounters and their specific times were used for the analysis.

4.4.1 Validity of the used instruments

IPAQ was initially developed and validated in adults aged 18-65 years from 12 countries (Craig et al. 2003). Validity testing has included common quantitative methods, most notably concurrent comparisons with objective measures and with other questionnaire (Fogelholm et al. 2006; Kolbe-Alexander et al. 2006; Ainsworth et al. 2006; W. Brown et al. 2004; Maddison et al. 2007; Timperio et al. 2004; Rosenberg et al. 2008; Timperio et al. 2003). Criterion validity for physical activity items on the short forms, as measured against an accelerometer, has been found acceptable, as it was similar to that reported for other self-reported measures (Craig et al. 2003). Estimates for sitting time on a weekday have been examined with a subsample from the 12 countries (D. Rosenberg et al. 2008). Time spent sitting on a weekday has been found to have acceptable test-retest reliability and criterion validity, as also measured against an accelerometer. Single-country studies, however, indicate that IPAQ may result in over-reporting of PA (Rzewnicki et al. 2003; Ainsworth et al. 2006; W. Brown et al. 2004; Fogelholm et al. 2006).

The QQ Instrument has been used in previous research and shown to be a valid instrument for self-evaluation of work productivity. Self-reported

productivity via the QQ instrument has been shown to correlate with the objective work output (Meerding et al. 2005). Not all losses are quantitatively expressible and a quality indication may therefore provide valuable additional information. The quality scale raises new questions as well, especially about how to treat answers on this scale. Straightforward multiplication of the quantity and quality components may provide an indication of total performance, translating qualitative into quantitative losses. However, although this combination seems adequate as a first attempt to combine qualitative and quantitative losses, this approach remains to be validated.

Sickness absence data was drawn from company records. These records are kept for payroll purposes and their validity for actual number of sickness absence days is compromised only by random mistakes and unreported short sickness absences. All employees are required to report sickness absences. For an absence longer than 3 days an employee needs to provide a certificate from a physician.

4.5 METHODS OF DATA ANALYSIS

The effect of co-creation on outcomes was estimated based on the intention-to-treat principle. Intention-to-treat analysis in a trial embodies two principles: all individuals randomized to the intervention group are included in the analysis, including those who drop out prematurely; and the effects are measured as randomized rather than based on treatment actually received (Little & Yau 1996). Thus, subjects who fail to comply with the intervention are analyzed as if treatment was received (MacPherson 2004). Employees who left for maternity leave, resigned, or retired by the end of the study period were excluded from analysis. The two employees who declined the use of their sickness absence data were excluded from analysis of sickness absence.

4.5.1 Data processing and treatment of missing data

Analysis of covariance (ANCOVA) was used for estimating differences between the intervention and control groups on physical activity, work productivity, and each secondary outcome. ANCOVA basically allows for equalizing initial differences between the groups. ANCOVA is a general linear model with a continuous outcome variable and two or more predictor variables, where at least one is continuous and at least one is categorical. The outcome variables used are quantitative. ANCOVA tests whether certain factors have an effect on the outcome variable after removing the variance for which quantitative predictors (covariates) account. The inclusion of covariates can increase statistical power because it accounts for some of the variability. The analyses were done in collaboration with a biostatistician using the statistical software R (www.r-project.com) and MATLAB.

The Hurdle negative binomial model was used for analyzing sickness absence in order to account for its discrete and non-Gaussian distribution. Hurdle models were used to model count variables, in which there is an excess number of zeros compared to what typical count processes account for, e.g., sickness absence days. It was assumed that the probability of having counts greater than zero resulted from one process and zero counts from another process. Hurdle models assume a two-stage process. The first process (the zero process) determines if the variable is zero or greater than zero. The second process (the count process) determines the value of the variable if it is greater than zero. In analyzing sickness absence, the zero process determined if a person has any sickness absences. The count process determined the number of sickness absence days, if any.

Logistic regression and zero truncated negative binomial regression were used to model the zero and count processes, respectively. Negative binomial regression allows for overdispersion, which is typical with count data (Barron 1992). This concept refers to the presence of greater variability in a data set than would be expected based on a given simple statistical model, such as Poisson regression. Sickness absence days of the previous year were adjusted by including them as a covariate in the model. For differences between the groups, a baseline-adjusted mean difference and its 95% Bayesian credible interval (CI) were reported.

An exploratory subgroup analysis with the outcome of physical activity at 12 months was also performed. The subgroups were compared to a reference level of a 40–49 year old female in the control group who met the ACSM guideline recommendations for physical activity and had at most seven sick days during the period. The effect modifiers assessed at baseline were personal characteristics (age and sex), self-rated physical activity, job characteristics and number of sickness absence day during the past year. Adherence to the intervention was analyzed as a mediator for the effect on sickness absences. The randomized population was divided to adhering (returned the questionnaire and participated in the physical test at 12 months) and non-adhering groups. A hurdle negative binomial model was used for assessing the adherence in relationship to sickness absence.

4.5.2 Statistical analysis of customer and provider interaction

Interaction for co-creation was operationalized as interaction within service encounters. Service encounters (phone calls, emails and secure web messages) could be analyzed within the intervention group only (Table 7). Service encounter effects on behavior change could not be modeled with the RCT that compares the differences between the intervention arms.

Table 7: Service encounters in the CoAct study

Service encounter	Definition
Phone call	Personal phone calls made by the coach to each individual regarding progress. Phone calls were used to encourage more physical activity.
Personalized online message	Personalized messages sent to an individual regarding progress.
Mass online message	General informative messages sent to all participants regarding the program or benefits of physical activity.
Text message	Reminders to download data to the online system or to attend physical testing were sent online.

The effect of service encounters on physical activity was analyzed using daily monitoring/accelerometers (Chapter 4.4) data. This data was not utilized in the intention-to-treat analysis on the effect of co-creation, as it existed only in the intervention group. Associations between co-created service encounters and

health behavior were analyzed with three different approaches, presented in the following.

In the first analysis, the interaction for co-creation within service encounters was analyzed to determine the impact of individual encounters on an individual's physical activity. In order to be effective as a means of co-creating health the interaction would have to affect behavior. An assumption was made that if a service encounter has a direct effect on an individual's physical activity behavior, the change will take place during the seven days following the service encounter. The basic idea was to test whether an individual increases his physical activity after receiving feedback and/or encouragement from a coach during encounters. Figure 14 illustrates the nature of the accelerometer data by plotting the daily physical activity and service encounters for one participant during a six-month period. Physical activity is expressed by daily MET minutes (Chapter 4.4).

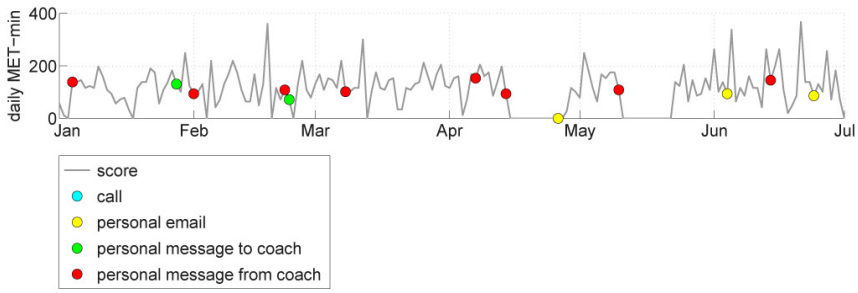

Figure 14: An example of an individual's physical activity and service encounter data

In Figure 14, daily physical activity is represented by the gray line and service encounters by various markers (see legend). Each employee's pattern of interaction was different, and the service encounters had different intervals and frequencies.

The short-term effectiveness of service encounters was evaluated in several complementary ways. Physical activity was visualized around the service encounters to find peaks or longer-term increases. More specifically, a time window of fixed length was placed in the physical activity around each encounter. Next windows were aligned and averaged over the encounters and

the employees. The time window started seven days before an encounter ended seven days afterward.

Statistical simulation was used to obtain 95% CIs for the average. For each 1000 simulation runs, service encounters were allocated randomly within the year and the averaged time window was computed as described in the previous paragraph. Then, the 2.5^{th} and 97.5^{th} percentiles of the simulated averages were used to form the 95% CI limits.

In the second analyses, average MET minutes were compared two weeks before and two weeks after service encounters. Averaging was done over the encounters, yielding a pre-encounter and a post-encounter average for each employee. The post-encounter difference in physical activity (MET minutes) was used as variable of interest.

Third, an exploratory subgroup analysis was done for sex, age, body-mass index (BMI), and maximal oxygen uptake (VO_2 max), the latter two of which were measured at baseline. Subgroup analysis refers to an investigation into whether the treatment effect is different in a subset of the patients defined by some baseline characteristic. Age was divided into three groups, and BMI and VO_2 max were divided into two groups. As previously, the post-encounter average was used as the variable of interest. The subgroups were compared using ANCOVA, controlling for the pre-encounter average.

CHAPTER 5

RESULTS

In this chapter the empirical analysis is presented. First enrolment and participation in the CoAct intervention study are described. Then the effect of co-creation on health is analyzed by examining effectiveness of the intervention. Third part analyses interaction for co-creation. The chapter ends in a summary of the results.

In order to discuss the effect of co-creation on health in the empirical examination, the enrollment and participant characteristics at baseline are first presented.

5.1 ENROLMENT AND PARTICIPANTS CHARACTERISTICS AT BASELINE

Prior to the CoAct study,[15] all 1116 Pohjola employees received a health risk appraisal as part of their normal occupational healthcare (Reijonsaari et al. 2009). A total of 817 employees answered the online health risk appraisal questionnaire and 596 volunteered for fitness testing making them eligible for the RCT. Health reasons excluded 46 employees from the fitness test. Leaving 550 employees invited to join the RCT. Immediately after the invitation, 6 employees were excluded according to pre-set criteria from the trial due to various reasons (e.g., expected/predicted/known retirement, unwillingness to participate).

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[15] The results of the RCT presented in chapter 5.1 and 5.2 are based on a publication examining efficacy of the CoAct intervention (Reijonsaari et al. 2012). They are here discussed to the extent relevant for the effect of co-creation.

Thus, the final study population of CoAct consisted of 544 employees who were randomly assigned to intervention and control group (Chapter 5.3). During the 12-month intervention and follow-up period, 23 employees retired, resigned, or left for maternity leave. These employees were excluded from the intention-to-treat analysis, leaving 264 employees in the intervention group and 257 employees in control group. The participant flow is presented in Figure 15.

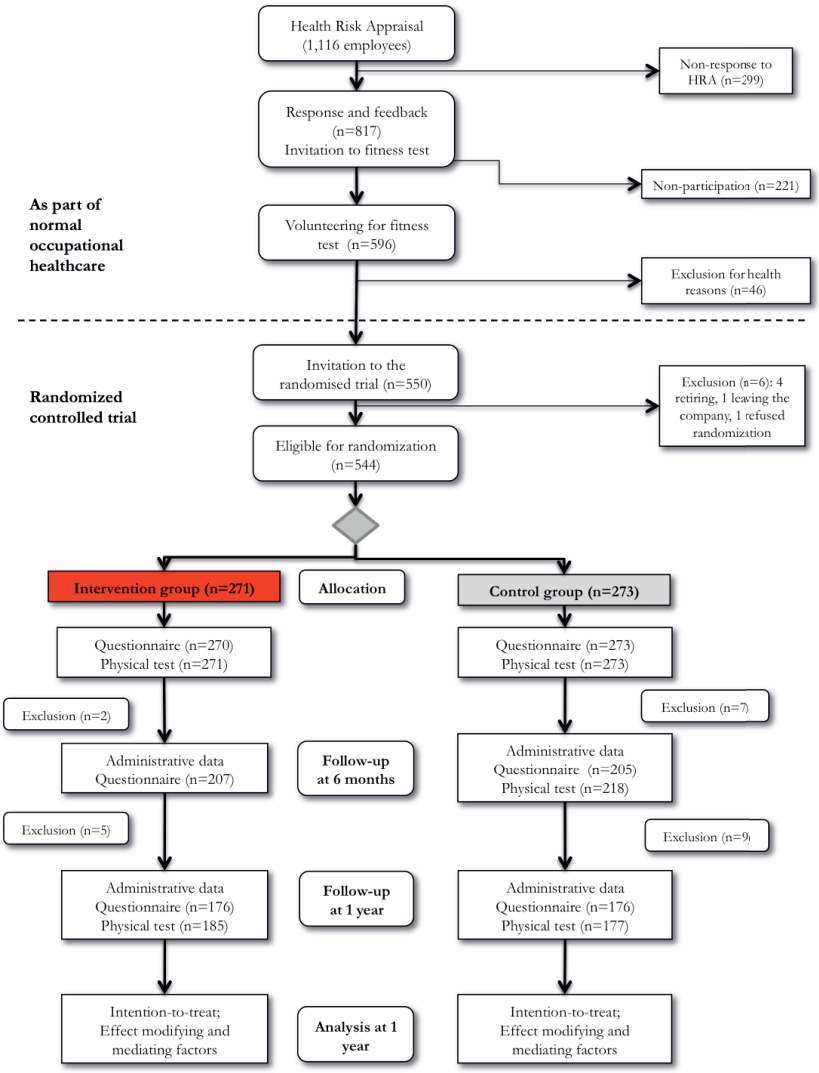


Figure 15: Participant flow (based on Reijonsaari et al. 2012).

At baseline, the participants were on average 43 years old (range 23–64 years). The majority of them (64%) were women and 90% were clerical employees. The participants were slightly overweight, with an average BMI of 25 (standard deviation: 4). The range for a normal BMI is 18.5-24.9. Based on self-reported data, only a few were completely physically inactive.

Seventy percent of the population met the ASCM physical activity recommendation of at least 600 MET minutes/week of at least moderate intensity exercise (Haskell et al. 2007). MET levels for walking, moderate activity and vigorous activity are 3.3, 4.0 and 8.0 METs respectively (IPAQ Research Committee 2005). As an example, 4.0 METs * 30 min/exercise * 5 exercises /week = 600 MET-minutes per week.

Table 8: Baseline characteristics in the intervention and control groups: mean (standard deviation) or count (percentage) within group (Reijonsaari et al. 2012)

	Control	Intervention
n	257	264
Age (years)	44 (10)	43 (10)
Gender (% female)	154 (60%)	180 (68%)
Clerical employees (%)	231 (90%)	236 (89%)
Body-mass index (kg/m2)	25 (4)	25 (4)
Meeting the ACSM guideline	185 (72%)	182 (69%)
Physical activity (IPAQ, MET min/week)	2 258 (1484)	2 114 (1439)
Work productivity (QQ index, range 0-100)	80 (22)	81 (20)
Sickness absence:		
None (%)	30	25
Mean (days)	7.4	6.5
Upper quartile (days)	8	8
Maximum (days)	200	88

As seen in Table 8, no relevant differences between the groups at baseline were found, indicating that the randomization was successful and treatment arms

were similar at the baseline. Successful randomization implies that groups were similar at baseline. This is an important prerequisite for an RCT to produce reliable results.

5.1.1 Loss to follow-up

As can be expected, not all employees returned the questionnaires or participated in physical testing during the intervention period. The loss to follow-up was considerable in both groups (Table 9).

Table 9: Enrollment at baseline, 6 months, and 12 months for intervention and control groups (Based on Reijonsaari et al. 2012).

		Baseline	6 months	12 months
Co-Act questionnaire	Intervention	264 (100%)	201 (76%)	175 (66%)
	Control	257 (100%)	200 (78%	176 (68%)
Physical test	Intervention	264 (100%)	215 (81%)	177 (67%)
	Control	257 (100%)		185 (72%)

As shown in Table 9, reasonable adherence was maintained: 66% of the intervention group and 68% of the control group returned the CoAct questionnaire at 12 months and 67% of the intervention group and 72% of the control group completed the physical test at 12 months. Some employees failed to schedule the physical test, were on holiday when questionnaires were mailed to them, or may have lost interest in the lifestyle intervention service.

Random factors were assumed for the missing fitness test results and responses to questionnaires at 12-months. Missing data was imputed with twenty random imputations. Covariates used for the imputation included items from the previous tests and questionnaires (age, gender, body-mass index, and

oxygen uptake).[16] Negative values from imputation were truncated to zero. Imputed values of work productivity were truncated to the allowed range (0-100).

5.2 EFFECT OF CO-CREATION

Research reviewed in Chapters 2 and 3 suggests that an effective lifestyle intervention service would support individuals through a process of interaction and exchange for co-creation in improving their health behavior, namely physical activity. If effective, the CoAct intervention service would cause the intervention group to have significantly higher physical activity then the control group at the end of the episode. A potential increase in physical activity is linked to work-related outcomes of productivity and sickness absence.

The intervention group's self-reported physical activity (MET minutes per week) decreased from baseline at 12 months (Table 10). The adjusted mean difference between the groups at 12 months was -207 MET minutes/week (95% CI: -531 to 116). The negative value favors the control group.

[16] Sensitivity analysis with regard to the imputation procedure was performed using complete case analysis. The complete case analysis used data only from the subjects who had completed the trial.

Table 10: Primary outcomes at baseline and 12 months: mean (standard deviation) or count (percentile) within group (based on Reijonsaari et al. 2012)

	Baseline		**12 months**	
	Control	Intervention	Control	Intervention
n	257	264		
MET min/week	2258 (1484)	2114 (1439)	2338 (1762)	2047 (1650)
ACSM guideline	185 (72%)	182 (69%)	173 (67%)	170 (64%)
QQ	80 (22)	81(20)	81(20)	81(20)
Sickness absence:				
None %	30	25	24	28
Mean	7.4	6.5	9.7	6.9
Upper quartile	8	8	10	8
Maximum (days)	200	88	219	87

Table 10 shows the outcomes and the number of subjects meeting the ACSM guideline in the intervention and control groups at baseline and at 12 months. Mean (standard deviation) or count (percentage) is shown for each group. The co-creation with the service relationship with daily activity monitoring was not effective in co-creating an increase in physical activity. The intervention group had 2114 MET minutes at baseline and 2047 MET minutes at follow-up. The differences were small and possible affected by certain individuals more than others (Figure 16).

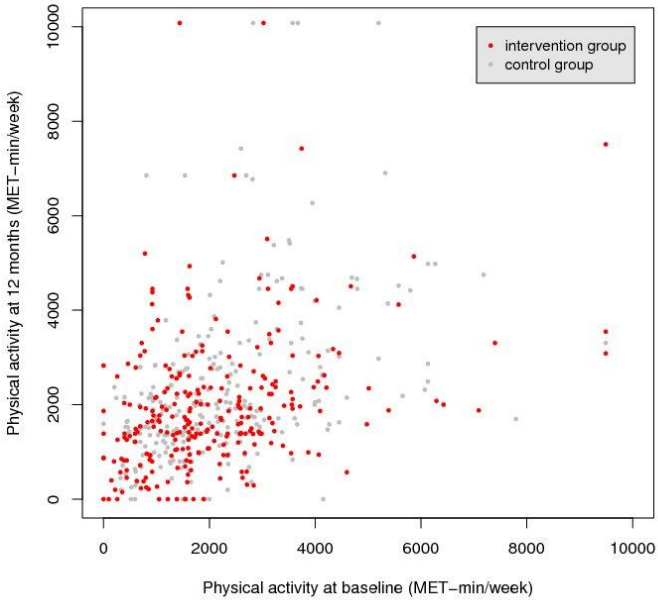


Figure 16: Physical activity (MET minutes) at baseline and at 12 months

Figure 16 shows, that some individuals reported significant changes in their physical activity at 12 months in comparison to baseline. This difference cannot, however be interpreted as an intervention effect, but as normal variation in behavior change over time compared to a similar population.

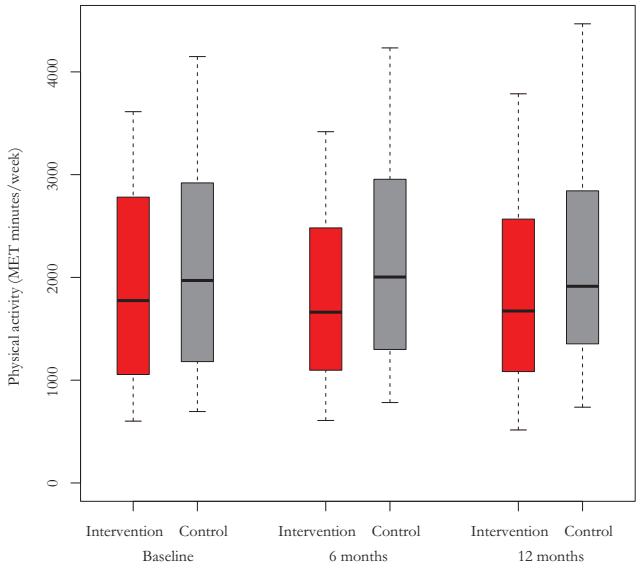


Figure 17: Physical activity at baseline, 6 months and 12 months

Figure 17 further illustrates the change in physical activity[17] and the fact that there were no observed differences between the groups at any time. The intervention group's self-reported (IPAQ) physical activity declined at 6 months and remained lower than the control group's at 12 months.

5.2.1 Work-related outcomes

Work-related outcomes of productivity (quantity and quality of work) and sickness absence were examined. The QQ score indicates the capability of the employee to perform productively at work (Figure 18).

[17] In a box-and-whisker plot, the bottom and top of the box are the 25th and 75th percentile (the lower and upper quartiles, respectively), and the band near the middle of the box is the 50th percentile (the median). The ends of the whiskers represent the range (minimum and maximum of all the data).

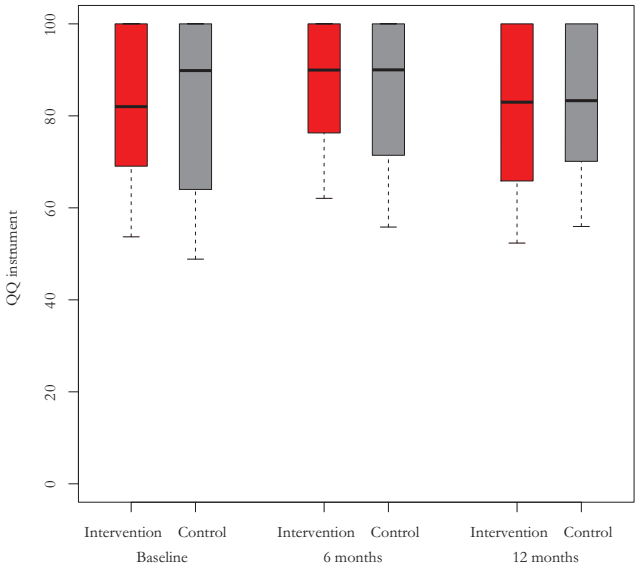


Figure 18: QQ scores at baseline, 6 months and 12 months

Figure 18 shows scores for work productivity estimates (quantity and quality of work). No difference between the productivity of the intervention group and the control group was found. The adjusted mean differences in the QQ index were 1.3 (-2.0 to 4.7) and -1.1 (-4.9 to 2.8) at 6 months and 12 months, respectively. The intervention service did not increase in productivity based on the QQ measures.

Sickness absence was operationalized as accumulated sickness days during the 12 months before the randomization compared to the 12-month intervention period (Chapter 4.4). The adjusted mean difference in accumulated sickness absence days during 12 months between the intervention and control groups was 0.0 days (-1.2 to 0.9), implying no difference in sickness absence between the groups. Figure 19 illustrates individual changes in sickness absence in the intervention and the control groups.

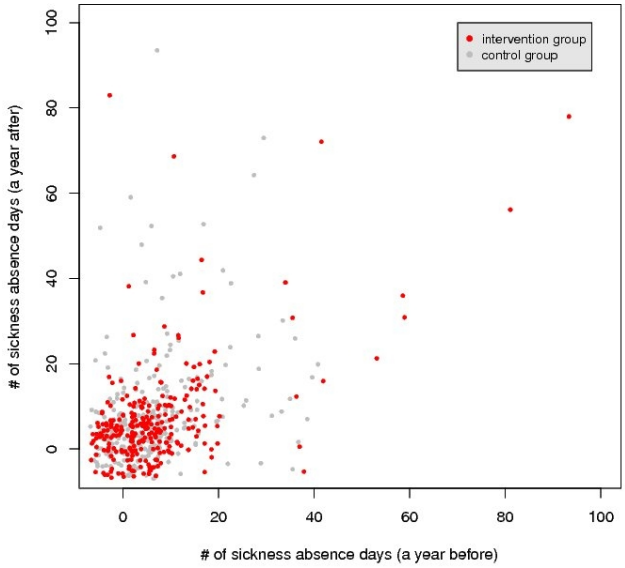


Figure 19: Sickness absence days during 12 months prior to the intervention and during the 12-month intervention period

Figure 19 also demonstrates that the distribution of sickness absence was heavily skewed toward high values. This type of distribution has been observed in other studies (Taimela et al. 2007). Substantial fraction of reported values is clustered at zero, and the long-tail of observations is formed from the few individuals that have long sickness absence periods. The largest number of sickness absence days for an individual in the study population was 219 days within the 12-month intervention period.

Changes in health indicators

Secondary outcomes measured include indicators of health (Table 11). Changes in body weight, body height, waist circumference, body fat percentage, blood pressure, and aerobic fitness were measured. Body weight increased slightly in the intervention group. The adjusted mean difference between the intervention and the control groups was -0,5 kg (95% CI: -1.0 to 0.0). The negative value favors the control group. Body fat percentage also increased slightly in the intervention group by 0.6 per cent units (-1.0% to -0.2%).

Table 11: Secondary outcomes at baseline and at 12 months (Reijonsaari et al. 2012).

	Baseline				12 months				Adjusted difference (95% CI)
	Control		Intervention		Control		Intervention		12 months
n	257		264		257		264		
Maximal oxygen uptake (ml/kg/min)	39	(8)	38	(8)	40	(9)	39	(8)	0.0 (-0.6 to 0.6)
Body weight (kg)	73	(13)	71	(14)	73	(13)	72	(13)	-0.5 (-1.0 to 0.0)
Waist circumference (cm)	86	(11)	85	(11)	86	(10)	85	(10)	-0.1 (-0.7 to 0.6)
% body fat	27	(9)	27	(9)	27	(8)	28	(8)	-0.6 (-1.0 to -0.2)
Systolic blood pressure (mm Hg)	138	(14)	136	(14)	137	(14)	135	(14)	0.3 (-1.8 to 2.4)
Diastolic blood pressure (mm Hg)	83	(9)	82	(9)	82	(8)	80	(9)	0.7 (-0.5 to 2.0)

Means and (standard deviations) within group and adjusted differences between groups at 12 months.
Negative differences favor the control group.

Subgroup analysis

Exploratory subgroup analysis revealed that the effect was not modified by sex, job characteristics, age, self-rated level of baseline physical activity, or sickness absence days in the year prior to the intervention (Figure 20).

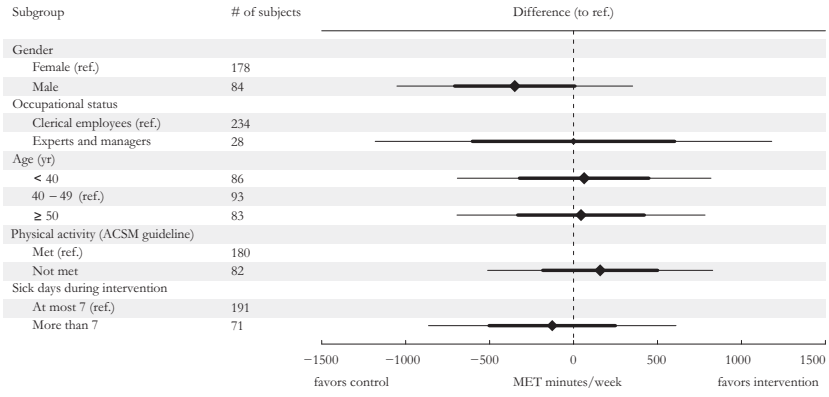


Figure 20: Results of the subgroup analysis (Reijonsaari et al. 2012)

The thick lines in Figure 20 show 68% CIs for the difference, and thin lines show 95% CIs. Adherence to the physical activity intervention did not mediate sickness absence: the mean difference between the adhering and non-adhering subgroups was 0.0 days (95% CI: -1.2 to 0.9; negative values favor the control group).

5.3 ANALYSIS OF THE INTERACTION FOR CO-CREATION

For the purposes of this analysis, co-creation was operationalized as interaction in service encounters between the service provider and the individual employee (see conceptual model in Chapter 2.5.2). The service encounters included in the analysis were phone calls, secure web messages, and emails. The content of these interactions is not included in the scope of this study.

Use of the online service declined during the 12-month service relationship. Employees averaged 15 logins during the last 6 months of the trial (0.6 times per week). Manual entries of physical activity were added to the database for 14% of the days in the first six months and 9% of the days in the second six-

month period. The level of interaction between the service provider and the employees also decreased. Service providers sent an average of 7.2 personal messages during the first 6 months and 6.1 messages to each employee during the last six months. Likewise, employees averaged 4.3 and 1.7 personal messages to the coaches during the first and the second six months, respectively. These numbers indicate a significant decrease in interaction for co-creation of the health outcomes over time.

Similarly, adherence to carrying the physical activity monitor daily decreased during the intervention (Figure 21).

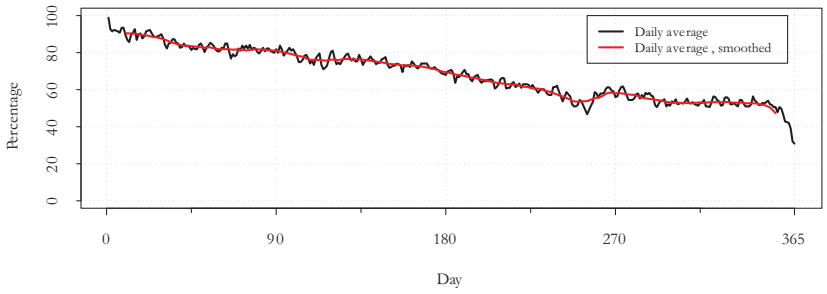


Figure 21: Proportion of individuals carrying the monitor daily

Figure 21 shows the portion of the employees using the physical activity monitor daily as aligned from the randomization day. The monitor is an operand resource and must be acted on to derive benefit. During the first two weeks, the employees wore the monitor on 91% of days implying that this resource was integrated into their value creation process at the time. The use of the monitor declined consistently over the intervention period, and during the final two weeks, the monitor was used daily by only 44% of the employees.

Daily physical activity measured by the physical activity monitors remained somewhat constant over the follow-up period. With regard to the long-term effectiveness of the service, Figure 22 illustrates average physical activity during the 12-month intervention period.

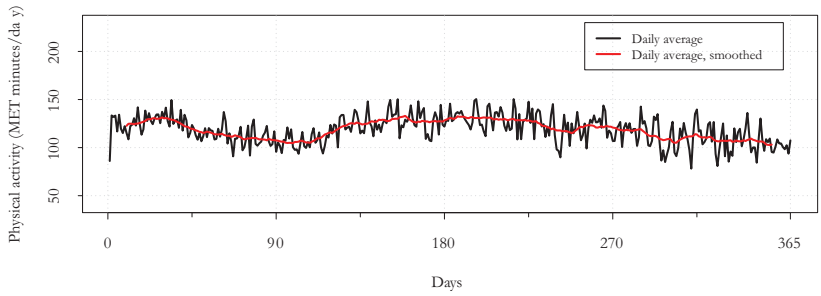


Figure 22: Average physical activity (MET minutes) during the intervention period (aligned)

In Figure 22, the black line shows the daily average and the red line a smoothed average over 10 days. The observation days are aligned starting from the randomization date.

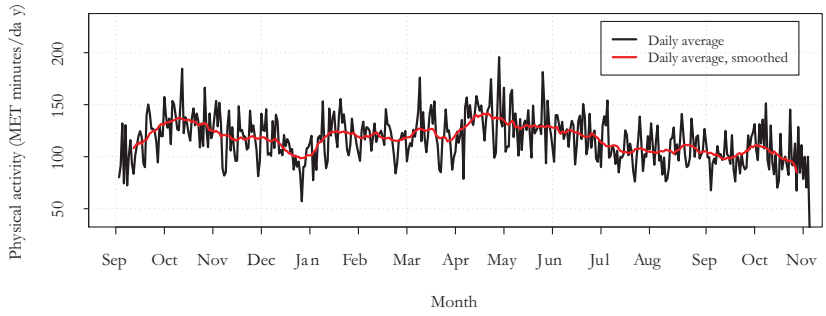


Figure 23: Average daily physical activity in MET minutes (non-aligned)

Figure 23 illustrates the same monitor data on physical activity, but this time it has not been aligned, but shown per each calendar day. Not aligning the data enables observation of the possible seasonal effects. The most significant drop in the daily average was right after Christmas, which can be explained by the holidays.

Physical activity during the first and last two weeks of the study was compared. Mean physical activities were 116 and 98 MET minutes/ employee/day, respectively. The difference of 18 METs equals around 6 fewer minutes in daily walking.

5.3.1 Effectiveness of interaction on physical activity

By examining data on interactions between employees and the intervention service provider using daily physical activity data from the accelerometers, it was possible to determine whether interaction for co-creation had short-term effects on physical activity.

First, possible relationships between different service encounters and changes in physical activity were analyzed by correlations over days following the service encounters (7 days before and 7 days after a service encounter). Figures 24-27 show the averaged time window for each service encounter type, and 95% CIs for average physical activity. The red lines show the average, and the grey area shows ninety-five per cent (95%) confidence intervals. N is the total number of the specific type of encounter.

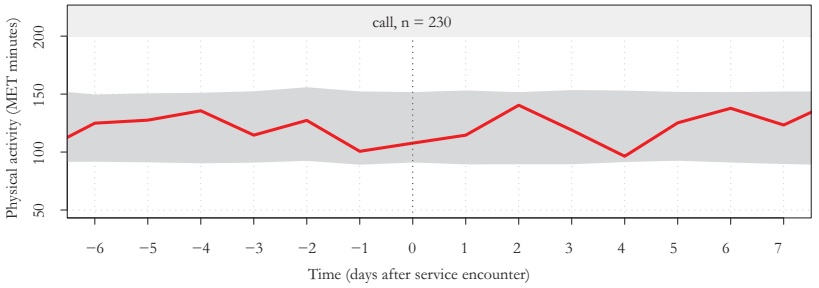


Figure 24: Average physical activity before and after phone calls.

Figure 24 shows average physical activity before and after phone calls between employees and the service provider. The interaction through these types of service encounters did not increase employee physical activity. A slight peak can be observed following the call, but the effect is minor (30 MET/week is roughly 10 minutes of walking).

The service process was designed so that individuals would get a phone call occasionally, especially if they had not downloaded their data every two weeks. However, the customers in the intervention group received only an average of 0.9 phone calls during the year, which indicates that the value proposition of the provider was inflated.

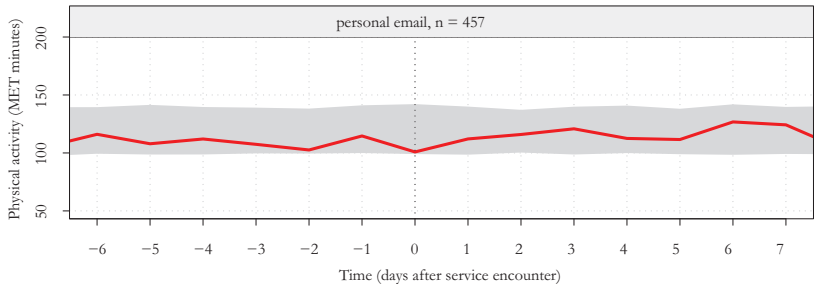


Figure 25: Average physical activity before and after personal emails.

Figure 25 shows that personal emails did not have an effect on average physical activity during the seven days following the service encounter.

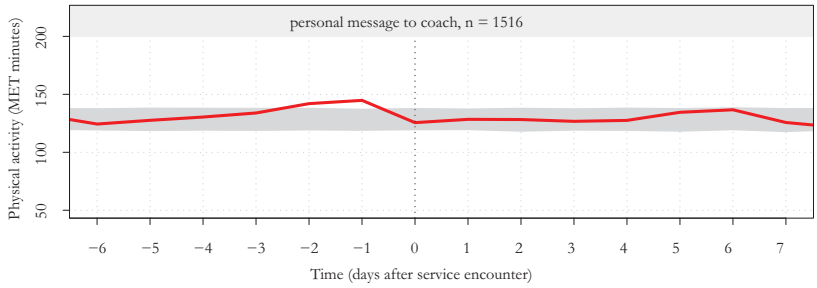


Figure 26: Average physical activity before and after personal messages to a coach.

Figure 26 illustrates that personal messages to the health coach did not have a significant effect on physical activity during the seven days following the service encounter. An increase in physical activity immediately **preceding** the service encounter can be observed. The change in physical activity is not significant enough to imply health benefits. This may imply a tendency to report activities retrospectively, as the employees were able to manually enter physical activity into the online service.

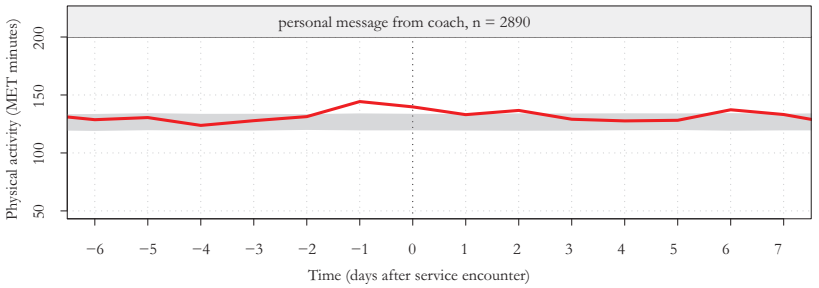


Figure 27: Average physical activity before and after personal messages from a coach.

As seen in Figure 27, physical activity was slightly higher immediately preceding receipt of a message from a coach. The change was not significant enough to imply health benefits and again, may be due to individuals retrospectively reporting physical activity. Overall, the observed difference was miniscule and cannot be expected to have health-altering effects even when not due to retrospective reporting.

Figure 28 shows a comparison of total physical activity (MET minutes) during the two weeks before and two weeks after each service encounter, partitioned by the type of the service encounter. There was no significant pre-post difference on physical activity after calls or personal messages to or from the provider. This indicates that the interaction for co-creation was unable to affect physical activity behavior. For personal emails, the encounters had a slight positive effect, but again the effect (an increase of roughly 8 to 17 MET minutes) was not large enough to mediate better health outcomes. As an example, 13 METs equals 4-minutes of daily walking.

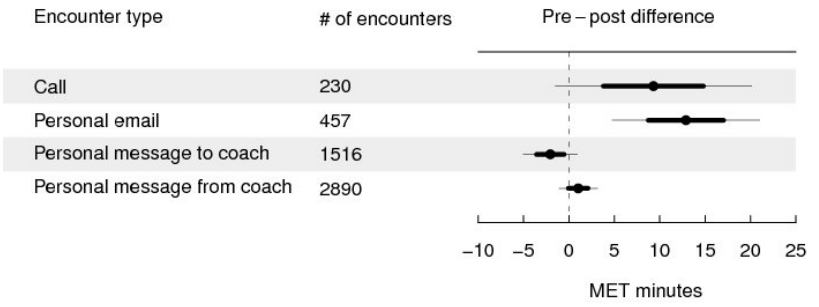


Figure 28: Comparison of the total physical activity a week before and a week after an encounter by encounter type.

In Figure 28, thick lines show 68% CIs for the pre-post difference, and the thin lines show 95% CIs.

Finally, in the explorative subgroup analysis (Figure 29), the subgroups were compared to a reference level of a 40–49 year old female with a BMI above the median (≥24.0 kg/m2) and VO_2 max below median (<2.6 l/min).

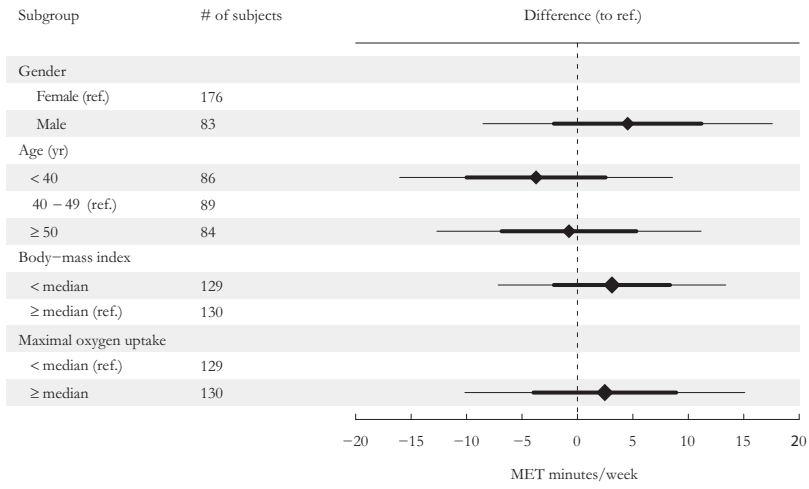


Figure 29: Explorative subgroup analysis results.

As illustrated in Figure 29, the difference in post-service encounter average physical activity was not significant in all subgroups after controlling for the pre-encounter average for physical activity. This indicates that the interaction did not have an effect on any of the subgroups (based on sex, age, BMI or physical fitness).

5.4 SUMMARY OF RESULTS

No effect of co-creation on physical activity, productivity or sickness absence was observed in this pragmatic randomized controlled trial. The intervention group's self-reported physical activity decreased from baseline at 12 months, implying that the service relationship had no positive effect on physical activity

behavior change. No difference between work productivity or sickness absence of the intervention group and the control group was found.

Analysis of the interaction examined the effect of phone calls, personal emails, and personal messages on physical activity. No significant short-term effect was found concerning any form of interaction for co-creation. The use of the monitor declined consistently over the intervention period, and during the final two weeks it was used daily by only 44% of employees.

CHAPTER 6

DISCUSSION

In this final chapter the contribution of the research is discussed and assessed from theoretical and empirical perspectives. The managerial implications are presented. Limitations and generalizability are discussed and methodological considerations presented. Finally, the chapter concludes with proposals for future research and conclusions.

6.1 CONTRIBUTION AND IMPLICATIONS

The purpose of this research was to examine the effects of co-creation on health. Research contributions and implications are discussed in response to the research questions as: a) *how can co-creation of health be modeled?* (theoretical contribution) and b) *what is the effect of co-creation in a physical activity intervention context?* (empirical contribution). Co-creation is discussed and proposed as a novel perspective for investigating interaction effects on health outcomes in this dissertation. In the occupational physical activity intervention service context, the health co-creation relationship is seen as a triadic interaction between employees, the intervention provider, and the employer. The empirical study examined the effects of co-creation on health and work-related outcomes within a commercially available physical activity intervention service selected by the case company. A pragmatic randomized controlled trial was selected as the study method.

The novelty of the perspective is based on the observation that health service research lacks studies examining the effects of co-creation on health outcomes. This dissertation contributes to the understanding of co-creation of health with an approach that combines service-dominant logic with a lifestyle intervention

service context. The research provides both academic as well as managerial implications.

6.1.1 Theoretical contribution and implications

Conceptual modeling and empirical examination of the effects of co-creation on health in lifestyle intervention service establishes the theoretical research contribution:

1. Clarification of co-creation in the context of health by extending the literature to address specific characteristics of the lifestyle intervention service context and specifically, a physical activity intervention service.
2. Conceptual modeling of co-creation of health extends previous models to account for third party involvement in co-creating health.
3. Extending the measuring value in health model (Porter 2010) to account for health behavior change as an effect-mediating factor.

Clarification of co-creation in the context of health

This dissertation extends the previous literature on co-creation by addressing special characteristics of a lifestyle intervention service. Prior to this study, health had already been recognized as a co-created outcome in service research (Bitner et al. 1997; Gummesson 2010; McColl-Kennedy et al. 2012). In this dissertation, the particular characteristics of co-creation in the lifestyle intervention service context were identified as 1) value of health as a capability, 2) health behavior change as a relationship performance measure (mediator of health and productivity outcomes), 3) cumulative nature of health as an outcome and 4) third party involvement in co-creation.

Different types of lifestyle intervention service targeting health behavior improvement were introduced as an important context for empirical examinations of co-creation. Prior research has not modeled co-creation of health or assigned context-specific relationship performance measures. This dissertation proposes measures for the effects of co-creation on health. In doing so, it answers specific calls for service research in this context. This research is the first attempt to address the effects of interaction for co-creation in a lifestyle intervention service with quantitative measures. Physical activity

interventions with daily monitoring of health behavior offer novel opportunities to examine interaction and co-creation activities' effects on outcomes through quantitative data.

Conceptual modeling of co-creation of health

The first research question, *How can co-creation of health be modeled?* was addressed by extending two models to account for particular characteristics of the lifestyle intervention context. The first model (Figure 8) extended the Grossman model of health production to account for interactive co-creation of value. The extended model clarifies the change in view from exchange-oriented production process to modeling interaction and exchange for co-creation of health. The extended model illustrates a possible interconnectivity between provider and customer resources, as well as an interactive co-creation relationship. It also exposes interesting similarities in health economics discourse and service research, such as their similar view on resource integration.

The second conceptual model developed here (Figure 30), extends the value co-creation model by Storbacka and Nenonen (2009) to highlight a third party's fundamental role in co-creation in the health context: health behavior as a mediator of health outcomes and value of health as a capability. Health outcomes may be co-created as a result of a physical activity intervention if participants significantly improve their physical activity and maintain the change. If the change is maintained, individual capabilities to perform productively can be improved. A positive change in an individual's physical activity and subsequently improved capabilities could indicate potential direct and indirect value capture for the employer at the population level.

The extended model was developed because the fundamental component of health service provision in the occupational context, the third party payer as an enabler of the service relationship, had not been explicitly modeled in previous service research. It is of economic significance for payers to understand whether outcomes really are co-created as a result of a service relationship they invest in, and the extent to which the service increases an individual's capabilities to perform productively at work. The extension contributes a model that can be used to evaluate relationship performance of different types of lifestyle intervention service in the occupational setting. The definition for

relationship performance is here extended to capture "the total value formed during the interaction between the firm and the customer" (Storbacka & Nenonen 2009) and to explicitly include the value capture of the third party in co-creation. Figure 30 presents three dimensions for relationship performance and context-specific outcome measures for each dimension of relationship performance.

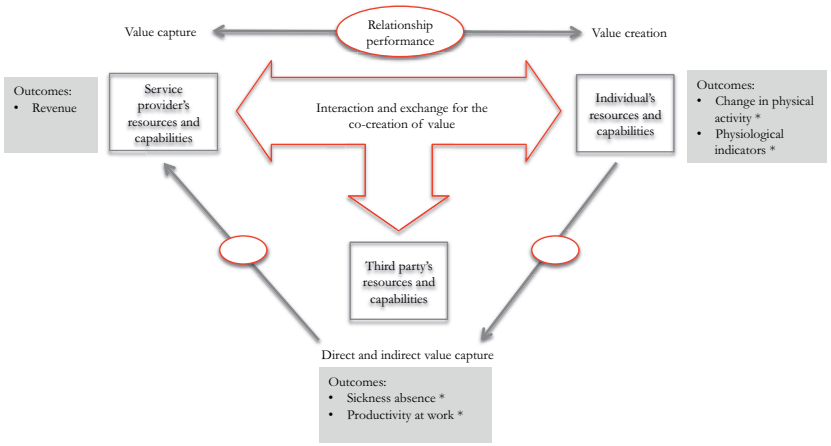


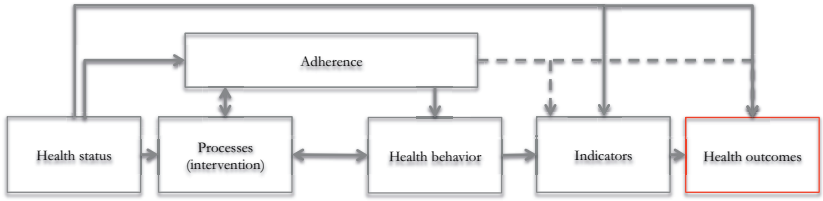
Figure 30: Model for interaction for co-creation of health and measured outcomes (denoted by asterisks *) (Extended from Storbacka and Nenonen 2009).

The primary outcome of the study was change in physical activity that would indicate future health outcomes for the individuals. The service provider's economic value capture is modeled as revenue from selling the service (not reported as an outcome in this dissertation). As the original model had not been used in the health context in previous literature, measures for context-specific triadic relationship performance were assigned for the empirical examination. The employer's value capture was operationalized as two primary outcome measures: productivity at work and sickness absence, which are seen as reflecting changes in individual's capability.

Extending the measuring value in health model

Health behavior was determined as an important outcome of the different types of lifestyle intervention service targeting chronic disease prevention. In order to examine the effect of interaction for co-creation on health behavior

change, Porter's model for Measuring Value in Health (2010) was extended to account for health behavior as an effect-mediating factor for health outcomes (Figure 31). The original model for value creation in health did not account for health behavior as a component and its mediating effect on health outcomes.



Health status	Process	Adherence	Health behavior	Indicators	Health outcomes
Health risk appraisal	Data on participation	Number of individuals carrying the accelerometer	Daily physical activity data	Body weight	Health outcomes are predicted on a population level from changes in health behavior and health indicators
Aerobic fitness test	Accelerometer data	Number of people using the online service	Self-evaluation of physical activity	Waist circumference	
Physiological measures (indicators)	Number and times of phone calls	Number of people answering to questionnaires		Body fat percentage	
	Number and times of online encounters	Number of people participating in the fitness tests		Blood pressure	
				Aerobic fitness (Vo2 max)	

Figure 31: Model for measuring the effects of co-creation (Extended from Porter 2010)

The extended model (Figure 31) assigns measures for relationship performance (effectiveness) in the lifestyle intervention context. This model contributes to service research and also extends the healthcare management discourse to include co-creation. Including health behavior as a mediator of outcomes has implications for how value in health service will be measured in the future. In order to empirically examine health behavior change as an outcome of a lifestyle intervention service on physical activity, the original Porter model was modified with correctives and clarifications (Section 2.5.2). Possible physical activity behavior change achieved as a service outcome was linked to changes in health indicator measures and the indicators were linked to health outcomes. The model further displays causalities between the different steps of co-creating health within a service relationship. It served as a framework for analyzing the effects of co-creation on health outcomes.

The implications are related to combining the S-D logic view on value, as co-created, to the lifestyle intervention context. The extended models highlight an

individual's central role in co-creation of behavior change and the cumulative nature of health outcomes. These models embody the specific characteristics of co-creation in the health context and extend the discussion on quantitative approaches for examining effects of co-creation.

6.1.2 Empirical contribution and implications

Findings

Service research addressing the health context has been largely conceptual in nature. The empirical contribution of this dissertation is the examination of co-creation with rich quantitative data from a real-life service with a rigorous RCT method. The second research question: *What is the effect of co-creation in a physical activity intervention context?* was addressed with an empirical examination.

This research is the first attempt to address the effects of co-creation with a method that meets the medical community's standards for effectiveness. Although co-creation in the health context has been discussed in previous service research its effects have not been linked to health behavior, indicators or outcomes as measures. Co-creation was operationalized as interaction based on definitions of co-creation (e.g., Vargo & Lusch 2008; Grönroos 2008; Storbacka & Nenonen 2009; Heinonen et al. 2010). The empirical study was designed based on the extended conceptual models and applied measures from the extended model for measuring value in health (Figure 32).

The primary outcomes for the co-creation effect were changes in physical activity, productivity at work, and sickness absence. No effect of co-creation was observed on any of these outcomes (Figure 32).

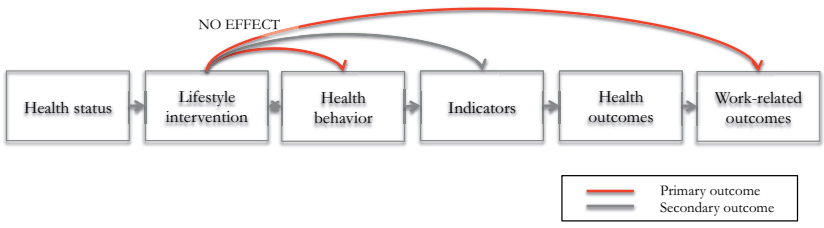


Figure 32: Summary of effects on primary and secondary outcomes

The secondary outcomes for co-creation effects included changes in health indicators (Figure 32). As with the primary indicators, no favorable changes were found. Given that changes in the indicators could have predicted possible changes in health outcomes over time, it can be concluded that it is highly unlikely that there were effects of co-creation on employee health.

Additionally, the effectiveness of interaction on physical activity was examined with interaction data. Subgroup analysis extended the RCT method to a realist approach. The interactions' relationship to daily physical activity (data from the accelerometers) reflecting customer actions for co-creation was analyzed. There was interaction between the employees and the service provider throughout the year in most examined encounter types. However, no encounter types had even a short-term effect on employee physical activity.

Implications

To interpret these findings, program failure and theory failure should be distinguished (Kristensen 2005). Program failure occurs, when treatment is effective, but the provider is not capable to deliver the intervention as intended, or subjects do not adhere to treatment protocols or treatment recommendations. Theory failure occurs, when subjects adhere to the treatment protocol and recommendations, but the treatment itself is not effective (Kristensen 2005).

In the present study, one element of program failure occurred. The provider did not make as many calls as promised. Its value proposition included calls to employees who did not download physical activity data to the online service every two weeks. Additionally, part of the value proposition was that service providers would call participants occasionally for encouragement and motivation. However, only 230 calls were made all together during the 12-month intervention period, which was less than one call per participant. The online message and physical testing were performed as intended. Large number of subjects in the intervention group carried the accelerometers voluntarily until the end of the study period possibly indicating that they experienced some value from the service. Adherence to the intervention was in line with previous findings (Carmody et al. 1980; Dishman 1982; Dishman & Sallis 1994).

Thus, to some extent theory failure likely applies to the idea that activity monitoring and distance counseling increases PA and subsequently, work productivity. There are several reasons supporting a conclusion of theory failure: 1) physical activity did not differ between the intervention and control groups, 2) health indicators (surrogate markers) measured favored the control group, 3) the interaction analysis did not find any of the encounter types affected on behavior change, 4) as shown in the subgroup analysis, the effect was not modified by gender, job characteristics, age, self-rated level of baseline physical activity, or sickness absence, and 5) the data has adequate statistical power for detecting relevant changes.

This research has implications related to the reasons for the limited effectiveness of different types of lifestyle intervention service, as follows:

1. Not all interaction is co-creation
2. The interaction for co-creation was not effective enough to establish and maintain significant changes in physical activity,
3. The technology used for remote monitoring of physical activity was not attractive and engaging enough to change daily activities.

Service-dominant logic sees that if there is value, it is always co-created (Vargo & Lusch 2008). Co-creation is characterized as interaction (e.g., Vargo & Lusch 2008; Grönroos 2008; Heinonen et al. 2010; Storbacka & Nenonen 2009), which was plentiful during the intervention period. However, no effect of interaction for co-creation was observed in the outcomes of the physical activity intervention service relationship: there were no changes in health behavior, health indicators, or ultimately, health outcomes. This empirical examination raises an important implication for theory, with the finding that not all interaction is co-creation. Activity in a service relationship may seem efficient as interaction takes place, but in reality, it may be that all necessary resources are not integrated into value creation. Previous studies have offered limited models and measures for examining the effect of interaction for co-creation on outcomes.

Second, the analysis on interaction for co-creation showed that the interaction in different types of service encounters was not effective in boosting co-creation of physical activity. The analysis showed that employees did not

respond to any of the encounters by making relevant short-term or long-term changes in their physical activity. This implies that this type of interaction is insufficient for changing health behavior of working adults. Although health may be changed as a result of an individual relationship, it often realizes during a longer time-span. This is especially the case in lifestyle intervention service relationships, which seek to accumulate lasting health behavior changes. Due to this delay in health outcomes, the actual immediate sacrifices needed for co-creation may outweigh the potential future benefits in a person's mind.

Value propositions of lifestyle intervention service are often built around the promise of improved future health outcomes. It may, however, be that the value individuals experience with these services is different and tied to shorter-term rewards, such as enjoyment of exercise, social recognition, or pressure related to participating in the program. If, in line with S-D logic, the service providers can only offer value propositions, customers will not engage in co-creation unless they see value. The participants of the CoAct intervention had agreed that they would like to pursue increased physical activity and had set a specific goal to do so. These concepts were generally not achieved.

Adherence to the intervention can be seen as an indicator of acceptance of the value proposition at some level. The success of value proposition in the CoAct intervention was highly dependent on customer input to co-creation. Based on this study, it is not possible to know why the service relationship did not fulfill its value proposition. Possible factors include individual determination of health as value, temporal aspect of valuing health, individual contexts and contents of the service.

Finally, the display of daily activity by the monitoring technology may not have been attractive enough to change behavior. Inactive people are often not aware of the fact that they are insufficiently active (Slootmaker et al. 2009a). However, just displaying their daily physical activity did not affect how they integrated resources to co-creation of increased health behavior.

6.1.3 Managerial implications

The research has managerial implications that can be summarized:

1. The results do not support implementing this type of an intervention service for a population of primarily healthy office workers.
2. When lifestyle interventions are implemented, their relationship performance should be measured quantitatively.

Lifestyle interventions are increasingly implemented in the occupational context without evidence of their effectiveness to change health behavior or increase an individual's capability to perform productively. Employers should explore the existing evidence on effectiveness carefully before making investment decisions. The results of this dissertation do not justify a wider implementation of this type of lifestyle intervention service among healthy, physically active office workers. Similar findings from simultaneously performed studies support this conclusion (Slootmaker et al. 2009a). Other types of service as well as service based on different theoretical premises should be examined for their abilities to co-create health behavior change and work related outcomes.

Additionally, when lifestyle interventions are implemented, the relationship performance of co-created health behavior changes and outcomes should be measured with a rigorous quantitative method. Currently different types of lifestyle interventions are implemented in the occupational setting without proof of their effectiveness. The extended models presented in this dissertation can be applied as a framework for analyzing effectiveness of various types of lifestyle intervention service. The work-related outcomes of increased productivity and decreased sickness absence reflect increased capability of the employees. These are valid measures from the perspective of employer value capture, and positive changes in them would justify the investments. Too often, the success of a lifestyle intervention service is measured by user feedback, which is prone to positive reporting bias. This fact may lead to allocation of resources into the types of service that are fun for users, yet do not enable behavior changes or improved health.

The ideas about co-creation of health presented in this dissertation have managerial implications beyond lifestyle interventions in the occupational

context. The notion of health behavior change as a co-created outcome that accumulates value beyond the duration of the service relationship has implications for a variety of different types of health, healthcare and wellness service. The fundamental goal of this research, to examine the effect of co-creation on health, should be considered in managing all service relationships targeting to change health behavior.

6.2 METHODOLOGICAL CONSIDERATIONS

Research quality in an epistemologically realist study may be assessed using four criteria: reliability, construct validity, internal validity and external validity. (Yin 2009; Gibbert et al. 2008).

Reliability describes confidence that the research process leads to particular outcomes (Winter 2000). RCT methodology is considered to have the highest standard in reliability for examining intervention outcomes when the method is executed to the detail (Plint et al. 2006). Replicability is an important aspect of reliability; this term means that other researchers should obtain the same outcomes if they follow the same process (Peat et al. 2002). Occupational epidemiology studies should aim for generalizability and replicability of results in similar occupational settings as study results are used as basis for investment decisions for lifestyle programs.

The opportunity to participate in the CoAct study was offered to all permanent employees (n=1116) of the case company, constituting a significant potential sample. The eventual participation rate of 49%, was similar to that of other lifestyle interventions studies in occupational populations (Robroek et al. 2009). Research has shown that about half of the participants in physical activity and exercise programs drop out during the first six months (Dishman & Sallis 1994). Statistical sample size calculation showed that the study population was large enough to show changes in physical activity outcomes (Reijonsaari et al. 2009). The methods of the CoAct study are replicable in similar settings, as the intervention used is commercially available and the study protocol was systematically described.

Validity in general is an estimate of the accuracy of an instrument (Peat et al. 2002). It refers to the degree to which variance in a measure is attributed to

variations in the variable, and not some other factor (O'Leary-Kelly & Vokurka 1998). Validity reflects an instrument's scientific utility in measuring what it is supposed to measure (Ketokivi & Schroeder 2004).

Construct validity concerns the operational measures used to reflect the observed constructs. Changes in physical activity and productivity outcomes were based on self-reports and therefore prone to recall and social desirability biases. Self-reported measures of physical activity have been found to be both higher and lower than direct measures (Prince et al. 2008). Though being validated instruments, their sensitivity to detect change may be suboptimal (Koopmanschap et al. 2005; Rzewnicki et al. 2003). However, the same applies to both the intervention and the control groups. A prerequisite of RCT design is pre – and post-measurement of outcomes. The only way to assess physical activity was through self-evaluation. This is a limitation, but it is unavoidable.

Sickness absence data was derived from company registers. This process, has several advantages: good coverage, accuracy, and consistency (Ferrie et al. 2005). Sickness absence data was available for all employees, whose employment continued at 12-months.

Commercially available intervention technology was used. The validity of the physical activity monitor has been shown (Slootmaker et al. 2009b), yet neither self-report questionnaires nor accelerometers are perfect measures of physical activity (Chinapaw et al. 2009; Slootmaker et al. 2009b; Cust et al. 2008). For example, accelerometers cannot provide contextual information about the type or purpose of specific activities. Also, due to the study design we could only track changes in physical activity for the whole population by the means of a questionnaire that may have been insensitive as an outcome measure.

Internal validity is the extent to which study results are reliable. A study has good internal validity if the measurements and methods are accurate and repeatable. When this is the case, differences in measurements between the study groups can be attributed solely to the effect of the intervention. Internal validity, the extent to which the design and conduct of the trial eliminate the possibility of bias, is a prerequisite for external validity: the results of a flawed trial are invalid and the question of its external validity becomes irrelevant. Good internal validity is indicated here because the randomization was successful, both groups were similar at baseline and the adherence to the intervention was similar to previous studies.

External validity, also called generalizability or applicability, is the extent to which the results of a study can be generalized to other circumstances. In clinical trials, external validity must be strictly defined and can be maintained by adhering to inclusion and exclusion criteria. Without strict adherence to these criteria, it is difficult to identify the population to which the results apply. Participant enrollment and a high response rate typically improve external validity (Peat et al. 2002). Inclusion and exclusion criteria in the CoAct RCT were in the study protocol and were adhered to throughout the study. The results can be generalized to similar populations of office workers.

6.3 LIMITATIONS AND GENERALIZABILITY

The facts that no information was gathered about a) the participants' baseline level of willingness or motivation to become more physically active and b) their opinions of the accelerometer device and distance counseling during and after the intervention can be considered limitations of the study. The study was designed to examine a service that could be offered to all employees of a company. The employer perspective was to understand whether offering this type of intervention to its employees could affect overall productivity and sickness absence. However, willingness and motivation to change health behavior are individually determined and are important factors for achieving outcomes. In the study by Slootmaker (2009a), a large part of the intervention population, using the same technology as this research, did not find the advice appealing. The content of the interaction was not customized to each employee, although previous research suggests that individuals have different motivations for health behavior change, and they respond to different kinds of incentives. This research did not collect information about these issues, which can also be considered a limitation.

Qualitative instruments could have provided insights as to why health behavior was not affected, how the employees valued the service and how they experienced the interaction. Although improved health behavior outcomes did not occur, it is possible that the employees viewed the service as of value. The absence of qualitative interviews, limits the explanatory power of the research presented here. However, it must be borne in mind that employer value capture - and therefore willingness to allocate resources into these types of

service - depends primarily on productivity outcomes. In the health context, resource allocation can rarely be based on positive service experience alone.

A participation bias must be addressed as an empirical limitation. All 817 employees who responded to the online health risk appraisal were invited to participate. Of them, 221 declined to take part in physical testing and randomization. Fifty-two employees were excluded from the baseline fitness test due to varying health reasons. Non-participants in previous lifestyle intervention studies have reported less interest about their health, less awareness of the benefits of physical activity or considered themselves already as doing enough physical activity (Kwak et al. 2006; Chinn et al. 2006; Spittaels & De Bourdeaudhuij 2007). As participation in the intervention was voluntary, the non-participation phenomenon is unavoidable.

A further limitation is that most of the participating employees were relatively active and in good basic health when the lifestyle intervention started. Given that physical activity interventions tend to attract people who are young, healthy, and already sufficiently physically active to maintain their health, this fact does not come as a surprise. This profile applied in the current study. Moreover, the employees excluded from the fitness test at baseline due to health reasons may have benefited from the intervention. Thus, the results may have been affected by selection bias, both from self-selection and exclusion of certain participants.

6.3.1 Generalizability

A discussion on generalizability is inevitably centered on the context in which any research was conducted. The CoAct intervention was performed in a Finnish insurance company. The study population consisted of all eligible employees of the company. Most were already physically active at baseline and of working age. With this said, the study's findings are generalizable only to similar occupational contexts of primarily healthy and already somewhat physically active populations. The same service may well be able to support lifestyle change in populations that receive incentives for improving their health behavior or are more highly motivated, such as groups with identified risk of chronic disease or significantly overweight people, but at the moment this claim is pure speculation.

It is recognized that the approach taken in this dissertation is not the only way to examine the phenomenon of co-creating health. This approach will be complemented by other approaches in the future, especially given that to the best of the author's knowledge, this study is the first attempt to measure the effect co-creation in the health context quantitatively.

6.4 PROPOSALS FOR FUTURE RESEARCH

This research has provided insight into the co-creation phenomenon in the lifestyle intervention service context. During the research process, some ideas for future research were generated. The following avenues for future research are proposed: a) further definition on the nature of co-creation in the health context, b) examining the networks of health co-creation and c) further interdisciplinary research combining service research and the health context.

6.4.1 Further definition of co-creation in the health context

The results clearly indicate that all interaction in a lifestyle intervention service is not co-creation of health. Future research should characterize interaction in the types of lifestyle intervention service that are able to change health behavior and determine if these characteristics can be generalized. Future service research in this context should build on the recently published clinical, psychological and health behavior knowledge on effective components of lifestyle interventions.

The author encourages future research to examine co-created value within a lifestyle intervention service by building on this research. Although no health or work-related outcomes were improved in the CoAct intervention, the study subjects may have experienced value from the service. Future research combining a quantitative analysis of effectiveness with a qualitative approach to service experience may provide insight into how customers determine value in this context. Understanding value as co-created encourages extending the perspective on value into other types of value (Sheth & Uslay 2007), such as

the customer's perceptions of value and personal experiences of unique value (Prahalad & Ramaswamy 2004a, b). In order to examine uniquely and phenomenologically determined value in a lifestyle intervention service a qualitative approach is needed.

Further examination of the customer value experience may help determine characteristics of effective interactions for health co-creation and design interactions. This information could boost immediate resource integration and customer input into co-creation. These ideas should be expanded beyond the lifestyle intervention context and examined in different types of health and healthcare service.

6.4.2 Examining networks of health co-creation

In the literature review, health was described as co-created in a network of resources and as individually, contextually, and temporarily determined. It would be interesting to extend the dyadic approaches to examining how an individual's health is determined during his life and in response to multiple, often simultaneous co-creation relationships. The current research extended the co-creation of health to include third parties as the first step toward understanding the networks of operant resources in health co-creation. Future research could extend the approach to account for more resources following the same logic of identification of resource integration and value capture. This would imply examining co-creation in a network of health determining resources (operant and operand). As such, it could not be approached with an RCT method that is capable of determining relationship performance of a single service. In widening the scope of analysis to networks, one must carefully consider how different determinants of health and multiple integrated resources interact over time.

Future research should also explore how relationship performance of a co-creation networked can be measured. Thus, research could explore the extent and effectiveness of resources integrated into an individual's health co-creation. This type of research should seek to increase the understanding of the effects of different resources integrated into a health value network.

6.4.3 Further interdisciplinary research

Previous knowledge from service research, health economics, management and lifestyle intervention research were found to complement one another in building deeper understanding on health co-creation. The results of this dissertation contribute not only to service research, but also to health management, health economics and intervention research. For example the extended model on measuring value in health is significant for all the synthesized research traditions. This effort has been a challenging, but rewarding, and it has pragmatic implications. It is the author's wish that these types of interdisciplinary contributions be continued, linking the extensive knowledge base on health and healthcare to service research and beyond.

Service research has presented ideas, such as value co-creation that have relevance for designing and managing different types of healthcare service. A thorough research effort is needed to understand the full implications for health as a co-created outcome. Changing physical activity, or any health behavior for that matter, requires consideration of the complex interplay among psychological, behavioral, genetic, and physiological determinants and consequences of the behavior – further integrating these discourses in future research may contribute a more throughout understanding of effectively co-creating health outcomes.

CHAPTER 7

CONCLUSION

This dissertation was motivated by a service research priority, understanding co-creation of value for improved well-being (Ostrom et al. 2010). The research contributes by further developing the theoretical discussion on the effects of co-creation in the health context and empirically examining the phenomenon. It also suggests that this type of physical activity intervention in the occupational setting may not be as effective as is popularly believed.

Models from service and health management research were extended based on synthesis of the literature to account for particular characteristics of the lifestyle intervention service context. The extended models build a foundation for examining effects of co-creation on health outcomes. The empirical exploration of co-creation effects provides a pragmatic examination of physical activity intervention service outcomes including health behavior change and two work-related outcomes: productivity and sickness absence. Use of the pragmatic RCT method is a rare addition to service research on co-creation, which has been largely conceptual to date.

This study clearly demonstrated that although activity and interaction occur in a service relationship, the desired outcomes are not always co-created, and increased capability may not be achieved. The results support the finding that individuals often fail to optimize their co-creation role (Dellande et al. 2004) even though providers seek to increase customer inputs to co-creation through interaction. Co-creation is interaction, but not all interaction is co-creation. This idea highlights the fact that as health resources become increasingly

scarce, their allocation should be based on the effectiveness of the different types of service in co-creating outcomes.

This research makes a contribution to how relationship performance of a lifestyle intervention service is modeled and measured in the occupational context. As a consequence, relevant questions for the future include: what kind of interaction succeeds in affecting an individual's resource integration and changes his inputs to co-creation of health? And what types of lifestyle intervention service succeed in co-creating health outcomes in occupational settings?

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Appendix 1: IPAQ short version

1a. During the last 7 days, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?
Think about *only* those physical activities that you did for at least 10 minutes at a time.

_____ days per week

1b.
How much time in total did you usually spend on one of those days doing vigorous physical activities*?*
_____ hours _____ minutes or none

2a. Again, think *only* about those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

_____ days per week

2b.
How much time in total did you usually spend on one of those days doing moderate physical activities*?*
_____ hours _____ minutes or none

3a. During the last 7 days, on how many days did you **walk** for at least 10 minutes at a time? This includes walking at work and at home, walking to travel from place to place, and any other walking that you did solely for recreation, sport, exercise or leisure.

_____ days per week

3b.
How much time in total did you usually spend walking on one of those days*?*
_____ hours _____ minutes or none

4. The last question is about the time you spent sitting on weekdays while at work, at home, while doing course work and during leisure time. This includes time spent sitting at a desk, visiting friends, reading traveling on a bus or sitting or lying down to watch television.

During the last 7 days, how much time in total did you usually spend *sitting* on a **week day?**

____ hours _____ minutes

APPENDIX 2: Quantity and Quality at work questionnaire

1. Please indicate how much work did you actually perform during regular hours today compared to a normal work day

   Nothing……. 1 2 3 4 5 6 7 8 9 10 ……. normal quantity

2. Please indicate what the quality of this work was compared with a normal work day

   Very poor quality…….. 1 2 3 4 5 6 7 8 9 10 …….. normal quality

APPENDIX 3: Exclusion criteria – physical testing

Exclusion criteria:

- Elevated resting blood pressure (BP)
  - Systolic BP over 170 and diastolic BP over 110
  - Systolic BP over 180 or diastolic BP over 110
- Fever at the time of testing
- Fever during the previous week
- Pregnancy
- Over 65 years of age
- Subject has been recommended by the occupational physician not to take part in heavy exercise

Subject fulfills at least 4 of the following risk factors:

- First-degree relative has suffered a myocardial infarction, has undergone a coronary by-pass operation or angioplasty or died due to cardiovascular disease under the age of 55.
- Current smoker (> a cigarette a day)
- Serum cholesterol > 5,2
- Resting blood pressure over 140/90
- Diabetes
- Morbid obesity (BMI > 40, waist circumference > 140 cm)
- Sedentary lifestyle

Study subject fulfills one of the following:

- Beta-blocker medication due to hypertension or arrhythmia. (Beta-blocker for migraine is not an exclusion criteria)
- Hypertension treated with at least 2 different drugs
- Coronary heart disease
- Cardiac valve disease
- Arrhythmia
- Pacemaker
- Heart failure
- Myocarditis
- Stroke
- Emphysema
- Chronic obstructive pulmonary disease
- Glycosylated hemoglobin A1c over 10
- Renal failure
- Chronic liver disease
- Claudication (Claudicatio intermittens)
- Cancer
- Myocardial infarction
- History of exercise-induced chest pain or shortness of breath without further examinations
- Disturbance in the cerebral blood flow within the past 12 months

- Major accidents or trauma within the last 6 months
- Major surgery within the last 6 months

Study subject fulfills one of the following medical problems:

- Varfarin-treatment (Marevan) initiated within the past month or the treatment targets have not been met
- Diabetes, diagnosed within the last month or the treatment targets have not been reached
- Increased ocular pressure (glaucoma)
- Rheumatoid arthritis in the active stage
- Unstable chronic liver disease
- Acute ventricular or duodenal ulcer
- Acute esophagitis
- Symptomatic anemia
- Acute hyper thyroiditis or other major thyroid problem
- Unstable asthma

Appendix 4: Related publications and research collaboration

Two journal articles have been published on the CoAct study in a clinical journal. These articles have been written in collaboration with colleagues as follows:

Reijonsaari, K., Vehtari, A., van Mechelen, W., Aro, T., Taimela S. *The effectiveness of physical activity monitoring and distance counselling in an occupational health setting - a research protocol for a randomized controlled trial (CoAct).* BMC Public Health 2009, **9**:494.

KR was the principal investigator, who developed the idea for the study, obtained funding for research and designed the study with STs advice. KR authored the protocol and was in charge of reporting the findings of this study. AV conducted the power calculations and advised on statistical matters in designing the study. TA and WvM provided expert comments. ST provided advice and guidance on the study design, prior research and the conduct of the study, and commented the study protocol.

Reijonsaari, K., Vehtari A., Kahilakoski, O-P., van Mechelen W., Aro, T. and Taimela, S. *The effectiveness of physical activity monitoring and distance counselling in an occupational setting – Results from a randomized controlled trial (CoAct). BMC Public Health 2012.*

ST was the principal clinical investigator. KR developed the idea for the study, managed the research process, data gathering, and obtained funding for research. KR and ST designed the conduct of the study and authored the article. O-PK performed statistical analyses and co-authored the corresponding parts of the article. AV advised on the analyses. VwM and TA provided expert comments.

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Unhealthy and sedentary lifestyles play significant roles in the increase in chronic diseases. Physical activity is one of the most important health behaviors in preventing and managing chronic disease. Lifestyle interventions, such as those targeting physical activity, are based on the idea of co-creation of value through interaction between collaborators. These types of service support individuals in changing health behaviors, and subsequently, improving health outcomes.

This dissertation studies the effects of co-creation in a physical activity intervention in an occupational setting. Employers are investing in approaches that increase employee physical activity because they have been linked to improved capability to work productively. The empirical study here provides a pragmatic examination of the effects of co-creation, including changes in health behavior, sickness absence, and work productivity. The work contributes to Service-dominant logic by clarifying co-creation in the context of health.

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