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# **MANAGING TECHNOLOGY IN EVERYDAY ACTIVITIES**

**A study of older adults with dementia, MCI, and  
no cognitive impairment**

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*“Du blir aldrig färdig, och det är som det skall.”*

Tomas Tranströmer  
Ur diktsamlingen ”För levande och döda” (1989)

## ABSTRACT

The general aim of this thesis was to generate new knowledge of the ability to manage technology in everyday life activities among older adults with or without cognitive impairment, how this ability can be assessed, and how knowledge of this can be translated into healthcare practice.

In **Study I** the psychometric properties of the Management of Everyday Technology Assessment (META) were investigated using a Rasch rating scale model. The META is used to assess the ability to manage everyday technology (ET) in older adults with and without cognitive impairment. In **Study II** the ability to manage ET, assessed with the META, was compared among three groups of older adults using ANCOVA. The groups included persons with mild Alzheimer's disease (AD), mild cognitive impairment (MCI), and no known cognitive impairment. Furthermore, in **Study III**, aspects that could influence the ability to manage ET in a sample of older adults with or without cognitive impairment were investigated using ANOVA. In **Study IV**, the applicability of a model with the intention to support healthcare professionals to advice and support technology use among older adults with dementia was investigated using a qualitative, constant comparative approach. The model included a one-day course, clinical tools, and interviews (focus group discussions and individual telephone interviews) during and after a period of clinical tryout.

The findings in **Study I** indicated that the META demonstrated acceptable person response validity and ET goodness-of-fit. The META could separate individuals with higher ability from individuals with lower ability to manage ET. **Study II** showed significant differences in ability to manage ET between all three groups. Persons with mild AD demonstrated the lowest ability, followed by persons with MCI and older adults with no known cognitive impairment. However, there were overlaps between the groups in ability to manage ET. In **Study III** three aspects that significantly influenced the ability to manage ET were found: variation in the intrapersonal capacities, central tendency in the environmental characteristics, and the diagnostic group. **Study IV** revealed that the healthcare professionals had had more focus on assistive technology than on ET. The model gave them an eye-opening experience of ET use among persons with dementia. They also described how they had incorporated the knowledge and tools in the model as a new way of thinking to support and inspire new investigations and to support collaboration. The model seemed to be an applicable way to translate knowledge produced in research into utilization in clinical practice.

This thesis contributed new knowledge about the ability to manage ET in older adults, particularly those with mild AD or MCI. The thesis also contributed important knowledge about aspects that influence the ability to manage ET, and this may have consequences for assessments and support of the ability to manage ET. Additionally, the findings indicated that the META is an assessment that generates valid measures of the ability to manage ET. The detailed information of the ability to manage ET gained from the META may be applied by researchers and clinicians. The thesis provided an applicable model of how research knowledge about technology use among older adults can be translated into clinical practice, and how this model can be used by healthcare professionals to support the ability to use ET for persons with dementia.

Key words: Alzheimer's disease, assistive technology, everyday technology, grounded theory, healthcare professionals, IADL, mild cognitive impairment, occupational therapy, older adults, Rasch measurement model

## LIST OF PUBLICATIONS

This thesis is based on the following publications, referred to in the text by their roman numerals:

- I. Malinowsky, C., Nygård, L. & Kottorp, A. (2011). Psychometric evaluation of a new assessment of the ability to manage technology in everyday life. *Scandinavian Journal of Occupational Therapy*, 18, 26-35.
- II. Malinowsky, C., Almkvist, O., Kottorp, A. & Nygård, L. (2010). Ability to manage everyday technology: A comparison of persons with dementia or mild cognitive impairment and older adults without cognitive impairment. *Disability & Rehabilitation, Assistive Technology*, 5, 462-469.
- III. Malinowsky, C., Almkvist, O., Nygård, L. & Kottorp, A. (Accepted). Individual variability and environmental characteristics influence older adults' abilities to manage everyday technology. *International Psychogeriatrics*.
- IV. Malinowsky, C., Rosenberg, L. & Nygård, L. Healthcare professionals' readiness to support technology use in everyday life for persons with dementia. In manuscript.

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## LIST OF ABBREVIATIONS

AD	Alzheimer's disease
ADL	activities of daily living
AMPS	Assessment of Motor and Process Skills
ANCOVA	Analysis of Covariance
ANOVA	Analysis of Variance
AT	assistive technology
ET	everyday technology
ETUQ	Everyday Technology Use Questionnaire
GLM	general linear model
IADL	instrumental activities of daily living
ICT	information and communication technology
MCI	mild cognitive impairment
META	Management of Everyday Technology Assessment
MMSE	Mini Mental State Examination
MnSq	mean square
MOHO	The Model of Human Occupation
OA	older adults with no known cognitive impairment
PADL	personal activities of daily living
SE	standard error



## PERSONAL INTRODUCTION

Ever since I started my doctoral studies I have had the belief that more knowledge is definitely required about older adults with and without cognitive impairment and their use of technology in everyday life. During my time as a doctoral student, I have been asked a lot of questions both about the persons as technology users and about the technology itself. The questions about the persons have mostly concerned the persons with dementia and doubts about whether persons with dementia can use technology at all. Do people with dementia really use technology? Isn't the use of technology too difficult for persons with dementia? When we talk about persons with dementia it seems to be common to think about persons with severe dementia living in nursing homes, and not about the majority of the people with mild to moderate dementia still living at home. Persons with dementia living at home need, as we all do, to cope with the increased use of technology in everyday life. They may need to use a microwave oven, automatic telephone services, or a cash machine. The questions I have had about the technology have reflected an unawareness of all the technology we have in our homes and in the community. Without clarifying examples, everyday technology seems to be hard to grasp. The word technology also appears to give associations to newly developed technology like computers and cell phones. Furthermore, the concept of persons with dementia and technology seems to lead the thoughts to assistive technology for safety and surveillance, and not to the technology like telephones, radios, and microwave ovens used in everyday life by the persons themselves. Hopefully, this thesis will bring more knowledge into this situation.

## INTRODUCTION

In our society there is a constantly ongoing technological development. The technology is nowadays a part of the world we live in and the use of technology is increasing, which affects the daily lives of most people. We are all expected to deal with a large number of technological artefacts and services such as remote controls, coffee machines, cash machines, and automatic telephone services, to be able to perform everyday activities in our homes, and to participate in society (Acevedo & Loewenstein, 2007; Mitzner et al., 2010; Mollenkopf & Kaspar, 2005). Due to the increased use of technology, the performance of many activities has changed (Emiliani, 2006). Invoices are paid through internet banking instead of with a visit to a bank office, and washing time in the laundry room is booked by logging in on a digital screen in the laundry room instead of using pen and paper. In many ways, the technology brings about many advantages in terms of efficacy and safety, but it is important to be aware that the technology sometimes can serve as a hindrance or even a potential hazard. Earlier studies show that older adults with dementia or mild cognitive impairment (MCI) often have a variety of technology in their homes, although its overall use has decreased and problems in using the technology are common (Nygård, 2008; Nygård & Starkhammar, 2007; Rosenberg, Kottorp, Winblad & Nygård, 2009a). A decreased ability to use technologies in everyday life may bring about a risk that the older adults are excluded from participation in activities at home as well as in society (Czaja et al., 2006; Mollenkopf & Kaspar, 2005). Persons with dementia and MCI have also been shown to perceive less technology as less relevant, and perceive the technology to be more difficult to use than do older adults with no known cognitive impairment (Nygård, Pantzar, Uppgård & Kottorp, 2011; Rosenberg et al., 2009a). However, more knowledge is needed about the ability to use the technology per se, i.e. the management of technology in everyday life for older adults with and without cognitive impairment. It is also important to translate this knowledge into clinical practice in information that is significant and meaningful to healthcare professionals (Baumbusch et al., 2008). The aim of this thesis is to generate new knowledge of the ability to manage technology in everyday life activities among older adults with and without cognitive impairment, of how this ability can be assessed, and how knowledge of this can be translated into healthcare practice.

## BACKGROUND

The main focus in this thesis is on older adults with cognitive impairment due to dementia or MCI, in comparison with those who have no known cognitive impairment, and on their management of technology in everyday life. In order to facilitate the understanding of this focus and the rationale behind the thesis, I will in the following chapters provide an introduction to the field. To begin with, the population in focus – older adults with and without cognitive impairment – will be presented. In order to shed light on the use of technology for this population it is of importance to first introduce the diagnosis of Alzheimer’s disease and mild cognitive impairment and the disabling consequences that follow from these in everyday life activities.

### Older adults with and without cognitive impairment

In Sweden, as in most countries, an increasing share of the population consists of older adults (Socialstyrelsen, 2009). In 2010, over 18% of the population in Sweden was 65 years or older and 31% was 55 years or older (Statistics Sweden, 2011). Older adults in Sweden often have an active life until their eighties, when several start to have difficulties performing everyday activities, and the need for support and assistance increase (Socialstyrelsen, 2009). One reason for a decreasing functional ability is cognitive impairments due to conditions like dementia (Agüero-Torres, Fratiglioni & Winblad, 1998). It is common in Sweden that older adults live in their own homes until well into old age, but sometimes support from significant others or home care services is needed (Socialstyrelsen, 2009). In this thesis, persons over the age of 55 years were considered as older adults, as cognitive impairments due to dementia and MCI can occur already at that age.

#### *Alzheimer’s disease*

Dementia diseases, such as Alzheimer’s disease (AD), vascular dementia, and frontotemporal dementia are common diseases of old age. In Sweden 142,000 people are estimated to be diagnosed with dementia (Socialstyrelsen, 2009) and in the European Union an estimated 7.2 million people have this diagnosis (Wimo, Jönsson, Gustavsson, McDaid, Ersek, Georges et al., 2010). The worldwide prevalence is

approximately 35 million (Wimo, Winblad & Jönsson, 2010). The most common form of dementia is AD, which affects about 50-60 % of all diagnosed (Blennow, De Leon & Zetterberg, 2006). AD is, like other dementia diseases, a progressive disorder which is described as proceeding from stages of mild to moderate to severe. AD causes a decline in multiple cognitive deficits such as executive function, language, and apraxia, as well as memory impairment (American Psychiatric Association, 2000). These cognitive deficits initially cause difficulties in performing vocationally and socially the instrumental activities of daily living (IADL) such as shopping and housekeeping. In later stages they also cause difficulties in personal activities of daily living (PADL) such as self-care and toileting (Desai, Grossberg & Sheth, 2004; Liu et al., 2007). In Sweden the National Board of Health and Welfare has assembled national guidelines for care in cases of dementia. In the guidelines, supporting the performance in everyday activities to prevent and reduce age-related physical and psychological changes is recommended (Socialstyrelsen, 2010). The focus in this thesis is on persons with mild AD still living in their ordinary housing and often having difficulties in social activities and IADL.

Persons with mild AD commonly live at home (Alzheimer Disease International, 2010), where they need to perform daily activities as everyone else does, and these activities increasingly include use of technology (Emiliani, 2006). As a result of medical treatment, the time a person with AD can live at home nowadays may be prolonged. This treatment's purpose is to improve the symptoms of AD, but the major focus is still to slow the progression of the underlying neurobiology of AD (Aisen, 2009). Consequently, persons with mild AD live at home for a longer period of time, continuing to perform PADL, IADL, and social activities, although generally not as well as before.

### *Mild cognitive impairment*

MCI is described as a transitional state between the normal cognitive changes of aging and the earliest manifestations of dementia (Petersen, 2004; Winblad et al., 2004). The general criteria for MCI are: subjective cognitive complaint (preferably confirmed by an informant), objective cognitive decline, relatively retained general cognition, essentially intact ADL and IADL, and not being demented (Petersen, 2004). The population-based prevalence for MCI in older adults (over 60 years) is reported to range from 11% to 17% (Mariani, Monastero & Mecocci, 2007). Petersen has proposed

four different sub-types of MCI: 1) amnesic MCI, 2) single non-memory MCI, with isolated impairment of a cognitive domain other than memory, 3) multiple domains amnesic MCI, with a slight impairment of multiple cognitive domains including memory and 4) multiple domains non-amnesic MCI with a slight impairment of multiple cognitive domains but without memory deficits (Petersen, 2004). The probability of developing dementia from MCI is proposed to be high; MCI can be seen as a precursor state to many dementias and the progression rate from MCI to dementia is approximately 10% per year (Mitchell & Shiri-Feshki, 2009). The different MCI subtypes may predict different dementia subtypes (Petersen & Negash, 2008) and the amnesic MCI subtypes are described as precursors to AD (Kim et al., 2009).

Although the diagnostic definition of MCI requires an essentially intact ability to perform IADL (Petersen, 2004), many recent studies have reported that people with MCI do experience difficulties in complex IADL (Giovannetti et al., 2008; Kim et al., 2009; Pernecky et al., 2006, Wadley et al., 2007). Even mild IADL decline in people with MCI is identified to be associated with a higher risk of progression to dementia (Artero et al., 2008; Pérès et al., 2006; Tabert, 2002). Recent research has recommended that the criteria for MCI may need to be reconsidered and revised, as people with MCI do not seem to have the essentially intact IADL ability that the diagnostic definition requires (Brown, Devanand, Xinhua & Caccappolo, 2011; Kim et al., 2009). In order to predict progression to dementia and to enable early interventions, further inquiry into the field of everyday functioning among people with MCI has also been called for (Bodine & Scherer, 2006; Hancock & Lerner, 2007; Jefferson et al., 2008; Kim et al., 2009; Winblad et al., 2004). More knowledge is needed about which areas of IADL and to what extent persons with MCI are affected, compared to older adults with no known cognitive impairment and persons with dementia (Farias et al., 2006, Teng et al., 2010). It has been suggested that the use of ET might be one area of IADL that is sensitive to early changes in cognitive decline in persons with MCI or mild dementia (Cromwell, Eagar & Poulos, 2003; Nygård et al., 2011; Pérès et al., 2006; Rosenberg et al., 2009a). Hence, in the following chapter the concepts of everyday technology and assistive technology will be explained. Later on in this introduction, use of this technology in everyday life and its relationship to IADL and participation in society for older adults with and without cognitive impairment will be described.

## Technology in everyday life

The concept of technology can be described and used in various ways. In this thesis, the concepts of everyday technology (ET) and assistive technology (AT) are used, and these will therefore be defined here.

### *Everyday technology*

The impact of technology in contemporary society is widespread, and technologies such as microwave ovens, cameras, TVs, and computers are increasingly part of everyday life for most people (Czaja et al., 2006; Mollenkopf & Kaspar, 2005). The ability to use this technology is more and more important for the performance of everyday activities and participation in society. In addition, the influence of technology requires adaptation to the technological artefacts and services, and also adjustment and change in our habits and skills (Bouma, 1998; Emiliani, 2006). The spread of new technology in society can impact on everyday life both positively and negatively. In one way, the technology can facilitate and support the performance of everyday activities, but in another way it is important to be aware that the technology could also be a potential hindrance (Larsson, 2009).

The term “ET” was defined by Hagberg (2008) as “technical objects which are used or designed to be used on a daily base, or more seldom but habitually”. In this definition technology is divided into two different forms: 1) technological artefacts and 2) technological systems. The artefacts are the objects themselves, such as cell phones or cash machines. Artefacts can be connected to each other in technological systems, as for example communication systems (Hagberg, 2008). Hagberg further elaborated on the ET term, “the term points towards doings in the household, during leisure or in the context of the individuals’ social network” (Hagberg, 2008). In this thesis, the term ET more specifically means the electronic, technical, and mechanical artefacts that exist in peoples’ everyday lives at home as well as in the community. This definition is based on findings from an earlier study (Nygård & Starkhammar, 2007) and on clinical experience which indicated that not only electronic artefacts but also technical and mechanical artefacts such as analogue alarm clocks and coin-opened doors in public toilets might represent hindrances for persons with cognitive impairment. ET may comprise both newly developed technology like the cell phone and the DVD, and more familiar technology like the stove or the toaster (Nygård & Starkhammar, 2007). ET

also includes electronic services such as internet banking or automatic telephone services.

### *Assistive technology*

Besides ET, sometimes assistive technology (AT) is used to facilitate everyday life. An AT is described in the Assistive Technology Act of 1998 as “any item, piece of equipment, or product system, whether acquired commercially, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities” (Assistive Technology Act of 1998). In Sweden, assistive technology may be provided by the county council for people living at home (Svensk Författningssamling, 2000). The prescription of AT is commonly an occupational therapy intervention (Hedberg-Kristensson & Iwarsson, 2003), and according to Swedish legislation the AT should be prescribed for prevention, treatment/training and/or for compensation (Wilow, 2001). Common ATs for persons with dementia living at home are those compensating for decreased memory and time perception like time aids and reminders (Nygård & Johansson, 2001; Topo, 2009), and those used for safety purposes such as stove timers and electronic tracking devices (Pot, Willemse & Horjus, 2011; Nygård, Starkhammar & Lilja, 2008). In the National Guidelines for care in cases of dementia by the Swedish National Board of Health and Welfare (Socialstyrelsen, 2010), the support and evaluation of AT use to promote independence for persons with dementia are recommended for healthcare professionals in Sweden.

The boundaries between ET and AT are becoming increasingly unclear and according to the definitions above the same artefact, for example a remote control with few buttons, could be seen as an ET for a person in one situation and as an AT for another person in another situation. In the thesis, the term technology is used in some instances to include both ET and AT when this is relevant. However, there are differences between ET and AT. The concepts are not interchangeable and for that reason ET and AT are sometimes described separately. In Sweden, as mentioned above, an AT may, after an occupational therapist’s evaluation, be provided by the county council for people living at home (Svensk Författningssamling, 2000), while ET is something you generally have to buy yourself. Furthermore, ET and AT might be viewed in different ways such as in what they communicate or symbolize to the user and others. An AT could on the one hand promote independence, security, and confidence to the user in everyday life (Hedberg-Kristensson, Dahlin Ivanoff & Iwarsson, 2007). However, on

the other hand it could pose a threat to the person's self-image or be experienced as stigmatizing and therefore not be used (Gitlin, 2002; Larsson Lund & Nygård, 2003; Rosenberg, Kottorp & Nygård, 2011). For example, a stove timer could be associated with older adults living in a residential care environment and thereby be rejected (Nygård, 2009). Use of ET has been described as something that can support a person's self-image, for instance use of a camera could support a person's identity and role as a photographer (Rosenberg et al., 2011) and this might be a reason for support of difficulties in technology use. As touched upon, use of ET and AT is influenced by several aspects. These aspects can be defined and investigated in various ways. To clarify the standpoint taken in this thesis, the theoretical framework will be examined next.

## Theoretical framework

This thesis aims to generate knowledge of the ability to manage ET in everyday life among older adults with and without cognitive impairment and about how this knowledge can be translated into healthcare practice. To understand and define how people could manage ET in their everyday lives, the studies have applied an occupational therapy perspective using the Model of Human Occupation (MOHO) (Kielhofner, 1995; Kielhofner, 2008). The MOHO is an occupational therapy conceptual practice model based on a dynamic systems theory. In this thesis the MOHO has been used to explain how the person's performance capacities, habituation, and volition interact with environmental conditions and influence the person's ability to manage ET. To enlighten the pedagogical issues of translating knowledge into practice in Study IV, the pedagogical ideas of the American philosopher and educational reformer John Dewey (Dewey, 1998) were used.

### *The interaction between person and environment*

To explain the person-environment interaction, the MOHO in part builds upon the often-applied General Ecological Model (Lawton & Nahemow, 1973). In the General Ecological Model the environment is described to be as important as the person for human behavior. The outcome of the interaction between the competence of the person (i.e. physical, psychological, and cognitive ability) and the environmental press (i.e. the demands of the environment) is adaptation. Adaptation is expressed in terms of adaptive behavior and

positive affect (Lawton & Nahemow, 1973). In the MOHO, Kielhofner describes the outcome of person-environment interaction as occupational performance (2008), further explained below. As described in the environmental docility hypothesis (Lawton & Nahemow, 1973; Lawton & Simon, 1968) a person with high competence and a capacity to interact with environmental press has a higher level of adaptation. On the contrary, a person with low competence and capacity to interact with environmental press will reach a lower level of adaptation. As the competence of the person decreases, the demands of the environment need to be lower to reach adaptation and vice versa. As dementia is a degenerative disease and persons with dementia are not expected to increase their competence to meet the environmental constraints, the supportive features of the environment are of particular importance for persons with dementia in reaching a higher level of adaptation (Giovannetti et al., 2007). Even though Lawton revised the model over time to be more complex, including personal and environmental resources, it has been criticized for describing physical, psychological, and cognitive ability as internal to the person as well as for not incorporating temporal dimensions of the person-environment interaction (Scheidt & Norris-Baker, 2003). For instance, an important temporal influence is the constant technological change that occurs in today's society, which may have consequences on person ability as well as environmental demands.

In addition to the views of the person-environment interaction in the General Ecological Model of Aging, the MOHO (Kielhofner, 2008) and other occupational therapy models (Christensen & Baum, 1997; Law et al., 1996) emphasize additional aspects that are important for performance of occupations (such as IADL, social activities). The MOHO proposes that within a person there are three interrelated components – performance capacity, habituation, and volition – that in interaction with the environment have an influence on occupational performance (2008).

In the MOHO, performance capacity refers to the person's capacities to do things depending on underlying objective and subjective physical and mental components. A person's volition forms the way that person sees the world and impacts on how the person performs occupations. Volitional thoughts are described as influenced by personal causation and the values and interests of the person. Habituation includes the person's habits and roles and shapes the person's everyday routines and attitudes as well as behaviors in involvement with others as home and in the community. The environment involves objects, spaces, social groups, culture, and economic and political conditions (Kielhofner, 2008). In addition to the

constant change in the environment as described above, a person's performance capacity, habituation, and volition are continuously changing during life. This complexity might be extra important to focus on for older adults with mild AD or MCI, as their conditions to manage everyday life are expected to constantly change because of factors like their cognitive decline and the increasing technological complexity in the home and society.

Within an occupational performance, actions, referred to as skills (motor skills, process skills, and communication and interaction skills) can be differentiated. During the actual performance, skills are dynamically brought together and used (Fisher & Jones, 2010; Kielhofner, 1995). Skills are not equivalent to underlying body functions such as cognitive and neuromuscular capacities or impairments; rather they describe the observable actions making up occupational performance (Fisher, 2009; Kielhofner, 2008). For example, in an occupational performance such as sending an e-mail on the internet, numerous skills can be distinguished, including selecting and using the appropriate device and pressing the correct keys with the fingers. The occupational performance of sending an e-mail, together with the performance of other occupations like making telephone calls and writing meeting minutes, can be part of what Kielhofner describes as an occupational participation such as working as a clerk in an office (2008).

The MOHO conceptualizes technological artefacts as objects in the environment. Objects are “naturally occurring or fabricated things with which people interact and whose properties influence what they do with them” (Kielhofner, 1995; Kielhofner, 2008, p.88). Kielhofner describes how the properties of an object – its size, texture, and familiarity can influence both how the object will be used and our behavior in using it. In other words, the interaction between a person and a technology can hinder as well as facilitate the occupational performance (Kielhofner, 1995; Kielhofner, 2008). However, the interaction with technology may differ from the interaction with other objects as the technology acts and interacts with the user in different ways than a book, a table, or a flower. A technological artefact or service often requires the person to respond, and respond in specific ways. When using a cell phone, for example, the user needs to understand and respond to directives that come up on the screen for accurate use. Objects also have symbolic meanings which could have an influence on occupational performance, like using a Smartphone or an iPad might identify the user as an up-to-date technology user (Kielhofner, 2008) while an unattractive AT can be perceived as a sign of old age (Rosenberg et al., 2011).

Occupations have been described as “the activities people engage in throughout their daily lives to fulfill their time and give life meaning” (Hinojosa & Kramer, 1997, p. 864). The concept of occupation always involves personal meaning and has contextual, temporal, psychological, social, symbolic, cultural, ethnic, and/or spiritual dimensions. As this thesis could be significant for others besides occupational therapists, the more commonly known concept of activity will be used interchangeably with the concept of occupation, although these two concepts may carry different meanings for occupational therapists.

Oftentimes in research, the person and the context and/or environment are considered one at a time and not in relation to each other. This dualistic view on person and environment has been discussed. Instead of focusing on a person’s performance in an occupation, a focus is suggested on the situation, of which the person is an essential part (Dickie, Cutchin & Humphry, 2006). This means the focus should be on the complex relationship between the person, the environment, and the occupation rather than considering them as separate components (Dickie et al., 2006; Law et al., 1996; Scheidt & Norris-Baker, 2003). However, as a step in clinical interventions such as measuring and describing the performance skills in the management of ET, it can be necessary to separate the person from the environment for practical reasons (Law et al., 1996; Scheidt & Norris-Baker, 2003).

#### *The translation of research knowledge into practice*

An important issue in healthcare research is translation of research knowledge into clinical healthcare practice, making research findings meaningful and useful to professionals (Baumbusch et al., 2008). It is also important to evaluate how the translation of knowledge into practice can be done practically (Baumbusch et al., 2008, Draper, Low, Withall, Vickland & Ward, 2009). In this thesis, the pedagogical ideas of the American philosopher, psychologist, and educational reformer John Dewey (1998) formed the basis for the view of learning how healthcare professionals can learn and translate knowledge into clinical practice. According to Dewey, learning, or how people learn, needs to be connected to reality and to have a purpose. Dewey also emphasized continuity and interaction in learning (Dewey, 1998). In the process of learning people’s past experiences influence their present, and in learning their past experiences interact with their present situations. Consequently, the person who is learning is actively involved in the process of learning by making the knowledge his or her own. Dewey’s pedagogical ideas were used as a basis for

learning in Study IV. There healthcare professionals' translation of knowledge, with the intention to advise and support the management of technology among older adults with dementia into clinical practice, was explored.

## Use of technology in everyday life among older adults with and without cognitive impairment

In the performance of everyday activities such as cooking, cleaning, and communication the use of technology is commonly considered a support. In the following chapter the knowledge base concerning use of technology in everyday life for older adults with and without cognitive impairment will be presented. Use of technology is described to have the potential to improve independence, participation, and social relationships (Mollenkopf & Kaspar, 2005) as well as to contain a safety aspect for older adults such as in the use of a telephone to call for help (Mitzner et al., 2010). Little attention is paid to plausible problems that use of technology may bring about for older adults. Technology might, for example, make everyday activities harder or even impossible to perform as they had been done before. The adjustment and change to the new technology as such might also imply a hindrance for an older adult (Larsson, 2009). Non-use of technology or difficulties in using the technology might moreover imply a risk of being excluded from participation in society (Bouma, 1998; Czaja et al., 2006; Mollenkopf & Kaspar, 2005). Not being able to use technology such as an alarm or a cell phone to call for help may lead to safety risks (Ala, Berck & Popovich, 2005; Nygård & Starkhammar, 2003). However, most studies on technology use among older adults focus on the use of ICTs like the use and non-use of computers and Internet (Czaja et al., 2006; Mollenkopf & Kaspar, 2005; Selwyn, 2003), or the use of ATs like monitoring systems or technology for safety (Gitlin, 2002; Molin, Pettersson, Jonsson & Keijer, 2007; Topo, 2009). Use of other technologies, ETs such as TVs, microwave ovens, and coffee machines, are also important in everyday life for older adults but have been less specifically focused on. Further research is needed (Rosenberg, 2009). Also, more knowledge is needed about the ability to manage the technology, and not only information about the use and non-use.

It is reported that use of technology among older adults in general is increasing (Czaja et al., 2006; Wagner, Hassanein & Head, 2010); nevertheless several studies report that

they still adopt and use technology less frequently than younger adults (Charness & Holley, 2004; Goodman-Deane, Keith & Whitney, 2008). Older adults in general as well as persons with cognitive impairments due to conditions like dementia or MCI have in previous studies shown to have numerous ETs in their homes (Nygård, 2008; Nygård & Starkhammar, 2007; Rosenberg et al., 2009a) even though persons with dementia or MCI perceived less ETs as relevant for them to use in everyday life than older adults with no known cognitive impairment. Compared to older adults in general, persons with dementia or MCI are found to perceive more difficulties in the use of ET (Nygård et al., 2011; Rosenberg et al., 2009a). One reason for less frequent use or non-use of technology among older adults might be their experience of problems when using technology (Czaja, Sharit, Ownby & Roth, 2001; Slegers, von Boxtel & Jolles, 2007). Another might be not considering the technology as relevant or needed in everyday life (Larsson, 2009; Nygård, 2008, Rosenberg et al., 2009a). The use and non-use of technology is also found to be associated with age (Selwyn, Gorard, Furlong & Madden, 2003; Tacken, Marcellini, Mollenkopf, Ruoppila & Széman, 2005), education, income and experiences, attitudes towards technology, and decrease in cognitive ability (Czaja et al., 2006; Mollenkopf & Kaspar, 2005). From these studies it is still not known how older adults can manage the technology.

Moreover, the design of the technology is known to be important for successful technology use. Technology is often developed and designed by younger adults and therefore it may not always meet the needs of older adults; older adults are thus at risk of being left behind (Eisma et al., 2004). For older adults with a cognitive impairment, design and familiarity of technology might be even more important (Cahill, Begley, Faulkner & Hagen, 2007a; Orpwood, 2009; Rosenberg, 2009) to maintain technology use in spite of progressive memory impairment and general cognitive decline. It may, for instance, be of extra importance for these users that the technology is flexible in use, simple and intuitive to use, and have tolerance for errors (Mäki & Topo, 2009). To design technology for older adults in general and specifically for persons with dementia, it is necessary for the designer to have insight into the needs of the users as well as into their problems in using the technology. One way to deal with this could be to involve persons with dementia and their caregivers in the development and design process (Eisma et al., 2004; Orpwood, 2009). However, more knowledge is needed about the skills required and used in the management of ET. This thesis may contribute

essential information about the ability to manage ET, as well as problems that may occur in the management of ET for older adults with and without cognitive impairment. For persons with dementia or cognitive impairment, in addition to ET, use of AT has been identified as an aid in maintaining independent living and increasing autonomy and safety (Cahill, Macijauskiene, Nygård, Faulkner & Hagen, 2007b). However, most studies of AT use are based on images of persons with severe dementia living in residential care environments (Topo, 2009). Studies focusing on AT use and support for persons with mild or moderate dementia still living at home are rare. Also, many studies concern safety issues for persons with dementia, for example by exploring home monitoring systems (Carswell et al., 2009; Kinney, Kart, Murdoch & Conley, 2004), tracking systems such as Global Positioning System (GPS) (Pot et al., 2011) or stove timers (Nygård et al., 2008). However, there are some studies describing the persons with dementia as AT users themselves (Nygård & Johansson, 2001; Rosenberg & Nygård, in press; Starkhammar & Nygård, 2008; Topo, Jylhä & Laine, 2004), showing that an AT can support a person with dementia in everyday life.

In AT interventions it is important to consider the user's interests and needs foremost, but the significant others' interests and needs are also important, (Alwin et al., 2007; Bjørneby et al., 2004). The process of bringing AT into the everyday life of a person with dementia is described as complex, and during the process difficulties can emerge (Molin et al, 2007). The different actors involved in the process, such as the person with dementia, the significant other, and professionals, can have diverse opinions of how the AT should be used (Bjørneby et al., 2004; Rosenberg & Nygård, in press), or the clients may experience non-participation in discussions about alternative solutions (Hedberg-Kristensson, Dahlin Ivanoff & Iwarsson, 2006). Obviously, it could be difficult to apply linear processes of prescription in these cases (Alwin et al., 2007).

There have been several generic models developed to describe the process of deciding and matching the appropriate technology (assistive technology) for a specific person. These include the Human Activity Assistive Technology Model (HAAT) (Cook & Hussey, 1995) and the Matching Person and Technology Model (MPT) (Scherer, 2004). In the HAAT model, an AT system is described where the person uses an AT to accomplish a defined task in a given environment. The technology is used to simplify the interaction between the person and the activity in the specific environment (Cook & Hussey, 1995). However, the HAAT does not explicitly suggest how the factors in the

system that influence the use of technology relate to each other and to the outcome (Lenker & Paquet, 2003). In the MPT, a person-centered and individualized approach is used to match persons with the most appropriate technologies for their needs. The MPT emphasizes that the interaction between the person, the environment, and the technology influence the technology use (Scherer, 2004). Even though the MPT identifies several personal and environmental factors that influence the use of technology, it is criticized for leaning more on the descriptive ones. In conclusion, these models provide knowledge about factors that may influence the use of technology like the person, the environment, and the activity as well as the interaction between these factors. However, the models are developed to describe and guide the process of matching and applying (assistive) technology to disabled persons, and not to evaluate the user's ability to use technology. Moreover, the models are developed for persons with physical impairments, not always considering the difficulties in technology use in everyday activities for persons with cognitive impairments such as dementia or MCI (Boman, 2009). Also, the models are not directed toward the well-known issue of how to translate knowledge into clinical practice, which in itself is problematic. Consequently, there is still a need for more flexible models for healthcare professionals to support interventions like prescription and evaluation of AT as well as use of ET and AT in everyday life for older adults. In the thesis, a newly developed model to aid healthcare professionals to advise and support the management of technology among older adults with dementia has been tried out. Also, an assessment of the ability to manage ET in older adults with and without cognitive impairment has been evaluated. In the following chapter, considerations will be presented about how to utilize research findings in clinical practice, using the concept of knowledge translation.

## Utilization of research in clinical practice

Healthcare professionals including occupational therapists are expected to perform organized and effective interventions in their professions. In order to ensure that these interventions are the most efficient and safest, it is important to base the interventions upon research evidence (Holm, 2000; Hutchinson & Johnston, 2004; Taylor, 2004). Evidence-based practice can support healthcare professionals in evaluating and treating clients adequately and improving client outcomes and healthcare services (Draper et al., 2009; Kent, Hutchinson & Fineout-Overholt, 2009). Still, there is a gap between the knowledge

generated in research and the translation of it into clinical practice (Draper et al., 2009; Jacobson, Butterill & Goering, 2003). Interventions may be implemented without being based on research evidence, and thus clients may be inadequately evaluated and treated (Vollmar, Butzlaff, Lefering & Rieger, 2007). There is a need to develop and further study the methods and processes for *how* evidence from research could be translated into clinical practice (Salbach, 2010). Various barriers, such as the organization, the quality of the research, the healthcare professionals' skills, beliefs and roles, and the communication and accessibility of the research findings (Hutchinson & Johnston, 2004) have been found to influence use of research in practice. An attitude of not considering the research as one's professional responsibility could influence the utilization of research negatively (Fänge, Risser & Iwarsson, 2007). Among facilitators to research utilization, more time to implement research findings, availability of research findings and colleague support are suggested (Hutchinson & Johnston, 2004). To bridge the gap between research and practice, models for application of research are needed to develop evidence-based practice. Evidence-based practice presupposes the application of research within the individual profession while in knowledge translation the focus is on the process of *how* to translate the research evidence into practice.

### *Knowledge translation*

Knowledge translation has been defined as “the exchange, synthesis, and ethically-sound application of research findings within a complex set of interactions among researchers and knowledge users” (Canadian Institutes for Health Research, 2004). The knowledge could be translated in different ways but knowledge translation is always more a process than a product, and an interaction between researchers and users is more than a one-way transfer from researcher to user (Jacobson et al., 2003). To enhance knowledge translation, both the researchers and the healthcare professionals should be actively involved in the learning process (Baumbusch et al., 2008; Salbach, 2010). This is in line with the pedagogical ideas of Dewey (Dewey, 1998). In addition, an important issue for the researchers is to translate the research findings into information that is meaningful for the users (Baumbusch et al., 2008). The information also needs to be appropriately adapted (Draper et al., 2009; Graham et al., 2006). Knowledge from research that is implemented into clinical practice can be presented in various forms such as general guidelines, specific recommendations, or tools like different assessments. In this thesis, a model for knowledge translation with the aim of aiding healthcare professionals to support the management of technology among older adults with dementia was tried out. For the implementation of assessments it is necessary that they

are evaluated and validated before they are put into practice. As evaluation of an assessment is a central issue in this thesis this topic will be introduced in the next section.

## Development of clinical assessments

To be able to systematically assess abilities to perform everyday activities there is a need for professionals such as occupational therapists to have reliable assessments to measure their clients' abilities. Assessments can provide knowledge about whether a client can or cannot perform a specific activity, and sometimes also why the client can or cannot perform the activity (Fisher, A.G., 1992b). Knowledge about a client's ability can be used to plan and evaluate interventions to support everyday activities.

Assessments can also give information that can be used to compare and separate groups from each other, and this is needed in the investigation of MCI and dementia (Teng et al., 2010). To make assessments useful both in research and in clinical practice, they need to be psychometrically evaluated to be valid and reliable for the specific population in focus and the purpose of the assessment (Kazdin, 2010). In the next chapter, the development of and the rationale for the Management of Everyday Technology Assessment (META) will be discussed.

In the process of instrument development, investigation of the psychometric properties of an assessment can be performed using different approaches. In classic test theory, it is assumed that data used are based upon interval or ratio scales (Bond & Fox, 2007). However, in assessing ability to perform ADL, ordinal scales are commonly used (Tesio, 2003). In an ordinal scale the distance between the scoring alternatives is unknown; we do not know if the distance between a score of 2 (minor difficulties) and 1 (major difficulties) is the same as between 2 (minor difficulties) and 3 (no difficulties). To overcome this issue, the Rasch measurement model can be applied. The Rasch measurement model is increasingly used in the development and validation of new assessments (Patomella, Tham & Kottorp, 2006; Rosenberg, Nygård & Kottorp, 2009b), as well as to validate existing assessments (Nilsson & Fisher, 2006; Petersson, Fisher, Hemmingsson & Lilja, 2007) measuring different aspects of human performance (Tesio, 2003).

With the Rasch measurement model ordinal raw scores are converted into abstract intervals through logistic transformation, and the linear relationship between persons and items can be described. Rasch measurement models are based on assertions which are probabilistic (Bond & Fox, 2007); observed responses are compared with the responses expected by the Rasch model. This means that a person's ability to perform an item can never be fully predetermined with the Rasch measurement model, as human behavior involves a necessarily unpredictable component (Wright & Linacre, 1989). However, if the data fit the Rasch measurement model, each person's ability and each item's difficulty can be calibrated on a common scale of the underlying construct, such as ability to use ET. In the same continuum, persons and items are positioned according to their ability or difficulty (Bond & Fox, 2007). In contrast with classical test theory, where items are summed up irrespective of to what extent each item is correlated to the underlying construct, the Rasch measurement model can estimate how well items perform regarding their relevance or usefulness of the underlying construct in the assessment. The Rasch measurement model can also evaluate the suitability of the categories in the rating scale (Bond & Fox, 2007; Tesio, 2003).

Use of ET targets a current and rapidly changing area, and the ability to use ET is important in most peoples' everyday lives. However, in existing ADL and IADL assessments the skills needed in the use of technology are commonly not considered (Ala et al., 2005). There are some assessments designed specifically to evaluate the ability to use a computer, but these assessments are not applicable to assessing the use of technology in general (Durmont, Vincent & Mazer, 2002; Fischl & Fisher, 2007). It has been proposed that development is needed of more sensitive assessment methods that can detect early changes in complex ADL and IADL in persons with mild AD and MCI (Bodine & Scherer, 2006; Hancock & Lerner, 2007; Jefferson et al., 2008; Pérès et al., 2006). One method of investigating ability in complex IADL could be to include the use of technology as a complicating aspect of everyday activities. In earlier studies it has been found that persons with dementia and MCI have various technologies in their homes, even if their overall use has decreased and problems in using technology are common (Nygård et al., 2011; Rosenberg et al., 2009a). In these previous studies, the *perceived relevance and difficulty in ET use* among older adults with and without cognitive impairment have been investigated using the ETUQ (Rosenberg et al., 2009a). However, gaining more in-depth knowledge about their *observed ability to manage the ET* could be valuable. With this in mind, the META was developed. The

META assesses the management of technology in everyday life among older adults in general, and especially for people with mild AD or MCI, in order to be able to plan and provide relevant individual support in ET use. The META involves observations and interviews of the performance ability in managing ET, and of the influence of intrapersonal capacities, environmental characteristics, and familiarity (Kielhofner, 2008) with the ET. The observations could identify important actions in the management of ET that are required to support the ability. The interviews could provide information about the client's own perceptions of his or her ability (Ejlertsen Wæhrens, 2010) that are important in interventions to support the ability (Fisher, 2009; Fisher & Jones, 2010; Kielhofner, 2008). In the studies of this thesis, the Rasch measurement model was used to investigate the psychometric properties of the META.

## Summary of the introduction

The literature review has shown that the increased use of technology at home and nearby requires people to adapt to using the technological artefacts and services in order to be able to perform everyday activities and to participate in society. This also holds for the growing populations of older adults with MCI or dementia. However, as well as being a support, the technology can be a potential hinder in everyday life for older adults in general, as well as for those with dementia or MCI. Research on technology and older adults has earlier focused on issues such as use and non-use of the technology as well as the perceived relevance and difficulty. Knowledge of the performed ability to manage the technology and also knowledge of aspects that could influence on the ability is sparse, though. Therefore, more research is needed focusing on the management of the technology among older adults with and without cognitive impairment due to causes such as MCI or AD.

In contrast to the diagnostic definition of MCI, requiring an essentially intact ability to perform IADL, persons with MCI seem to have difficulties in various complex IADL activities including perceived difficulties in use of technology. In order to better identify persons with MCI at risk of developing dementia, further studies about their ability to perform IADL are needed. Moreover, as persons with low ability to use technology could be at risk of being excluded from participation in everyday activities and society, it is of importance to identify those persons through valid

assessments. Additionally, to support the ability to manage technology in everyday life there is a need for detailed knowledge of the ability gained through systematic observations and interviews, and also to explore aspects that influence the ability. To aid healthcare professionals in supporting older adults with and without cognitive impairment in everyday activities where technology is used, one important issue is to translate knowledge gained from research about technology use among older adults into clinical practice. There are models and recommendations for supportive interventions of technology use, but it is not clear how these models could support healthcare professionals in the process of translating research findings into clinical practice. Therefore it is also important to focus in research on how the knowledge can be translated into practice.

## RESEARCH AIMS

### General aim

The overall aim of this thesis was to generate new knowledge about the ability to manage technology in everyday life activities among older adults with or without cognitive impairment, about how this ability can be evaluated, and about how the knowledge can be translated into healthcare practice.

### *Specific aims*

- To investigate the psychometric properties of the Management of Everyday Technology Assessment (META), and to examine those specific performance skills that together are proposed to make up the ability to manage ET for older adults in general and specifically for people with MCI or AD (Study I).
- To investigate how older adults with mild AD or MCI, in comparison with older adults with no known cognitive impairment, manage ET in everyday life activities, in the context where it is familiar and relevant to use (Study II).
- To identify aspects that influence the ability to manage ET among older adults with or without cognitive impairment (Study III).
- To investigate the applicability of a model with the intention of supporting healthcare professionals, to advise and support within their professions the management of technology among older adults with dementia. An additional aim was to explore the process of how this model could be translated into healthcare practice (Study IV).

## METHODS

### Study designs

In this thesis different methods were applied to develop knowledge of the ability to manage technology in everyday life activities among older adults with mild AD, MCI, and with no cognitive impairment, and to explore how knowledge of this ability can be translated into healthcare practice. An overview of the four studies in the thesis is presented in Table 1.

Table 1: Overview of the four studies included in this thesis.

	Study I	Study II	Study III	Study IV
<b>Focus</b>	Investigate the psychometric properties of the META	Compare ability to manage ET in three groups	Identify aspects that influence the ability to manage ET	Investigate the applicability of a model to translate research into practice
<b>Design</b>	Cross-sectional, quantitative study	Cross-sectional, quantitative study	Cross-sectional, quantitative study	Qualitative pilot study
<b>Participants</b>	116 older adults with mild AD, MCI, and no known cognitive impairment		110 older adults with mild AD, MCI, and no known cognitive impairment	11 healthcare professionals
<b>Methods of data collection</b>	Observations of ability to manage ET using the META	Raters' observations and participants' self-reports in ability to manage ET using the META	Observations of ability to manage ET using the META	A one-day course, focus group interviews, and individual telephone interviews
<b>Data analysis</b>	Rasch rating scale model	Rasch rating scale model, ANCOVA, Cohen <i>d</i> , descriptive statistics	ANOVA, descriptive statistics	Constant comparative analysis

### Participants and criteria for selection

The population focused on in this thesis is that of older adults in general, and specifically persons with mild AD or MCI, living at home. In Studies I-III persons with

AD, persons with MCI, and older adults with no known cognitive impairment (OA) were included as participants. In Study IV the participants comprised healthcare professionals working clinically with persons with dementia and their significant others. Characteristics of the participants are presented in Table 2.

Table 2: Characteristics of the participants.

	<b>Participants</b>	<b>Gender, n (%)</b>	<b>Age, years Mean (SD) range</b>	<b>MMSE Mean (SD) range</b>	<b>Education, years Mean (SD) range</b>	<b>Living situations, n (%)</b>
<b>Study I and Study II n=116</b>	Mild AD, n=38	Men:	75.29	23.53	10.45	Cohabiting: 20 (53) Single: 18 (47)
		18 (47)	(9.09)	(3.26)	(3.13)	
		Women:	58-89	17-29	5-17	
		20 (53)				
	MCI, n=33	Men:	70.45	27.52	11.14	Cohabiting: 25 (76) Single: 8 (24)
		19 (58)	(8.40)	(1.87)	(3.66)	
		Women:	57-87	24-30	5-19.5	
		14 (42)				
	OA, n=45	Men:	73.22	29.27	11.08	Cohabiting: 23 (51) Single: 22 (49)
		16 (36)	(9.73)	(1.07)	(3.08)	
		Women:	55-92	27-30	6-18	
		29 (64)				
<b>Study III n=110 (same as Studies I &amp; II)</b>	Mild AD, n=35	Men:	75.54	23.51	10.49	Cohabiting: 18 (51.5) Single: 17 (48.5)
		18 (51.5)	(9.21)	(3.40)	(3.26)	
		Women:	58-89	17-29	5-17	
		17 (48.5)				
	MCI, n=33	Men:	70.82	27.48	11.05	Cohabiting: 25 (76) Single: 8 (24)
		19 (58)	(8.55)	(1.90)	(3.60)	
		Women:	57-87	24-30	5-19.5	
		14 (42)				
	OA, n=42	Men:	72.55	29.38	11.30	Cohabiting: 23 (55) Single: 19 (45)
		17 (40.5)	(9.65)	(0.99)	(3.04)	
		Women:	55-92	27-30	6-18	
		25 (59.5)				
<b>Study IV n=11</b>	Health professionals	Men: 47 1 Women: 10	47 29-60			

### *Participants in Studies I-III*

Older adults with varying cognitive abilities, living at home, constituted the samples in the three first studies in the thesis. A sample comprised three groups of participants: persons with mild AD, persons with MCI, and OA. In Study I, a combination of participants with and without cognitive impairment was chosen, as this was proposed to lead to a variety in the sample ability. This was expected to increase reliability and separation (Bond & Fox, 2007). In a sample with spread in ability, it can be examined whether an assessment can measure and separate persons with more as well as less ability. In Study II the three groups were further examined in order to enable comparisons between the groups. The sample size for each group was estimated as at least 33 people. This was based on power analysis with a power of 0.8 and  $p < 0.05$ , in order to secure a mean difference of 0.8 logits between groups to allow investigation of whether the META had the ability to separate the three groups from each other according to ability to manage ET. In Study III, a combination of participants with and without cognitive impairment was chosen, as the aim was to explore aspects that influence the ability to manage technology among a sample of older adults with or without cognitive impairment

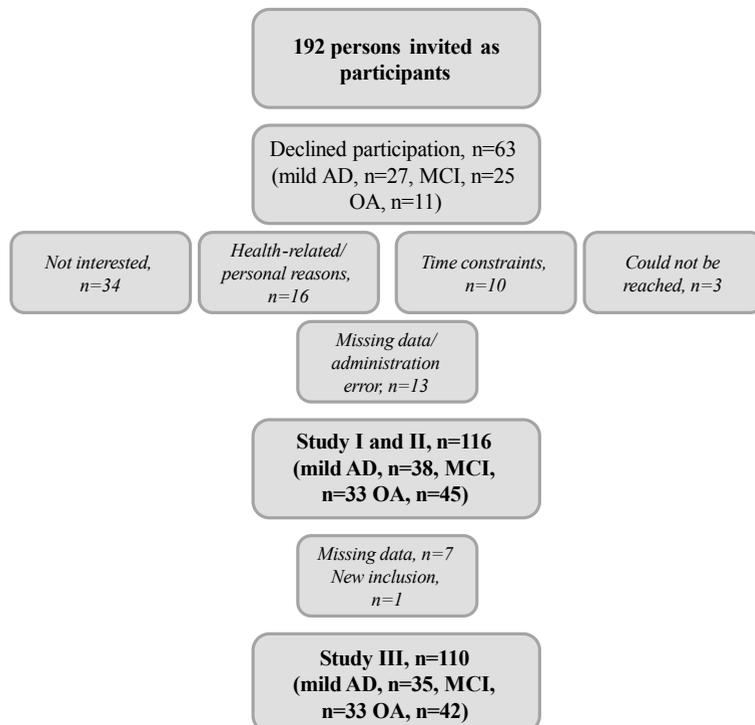
A general inclusion criterion for all participants was an age of 55 years or older. This was chosen because MCI and AD can occur as early as at the age of 55. Participants were to be engaged in everyday activities; they should to some extent manage common technology in everyday life. People with visual and/or hearing impairments were included as long as their impairment(s) could be compensated with aid(s). Furthermore, an MMSE score (Folstein, Folstein & McHugh, 1975) of a minimum of 18/30 for persons with mild AD, 25/30 for persons with MCI, and 27/30 for older adults without cognitive impairment was used as an inclusion criterion. These cut-off scores were suggested by Fahlander (2002), based on Folstein et al. (1975). People with AD or MCI were excluded if they had other documented and diagnosed diseases that could cause their cognitive impairments, such as stroke or severe depression.

Participants with mild AD (or mild AD combined with vascular dementia) or MCI were, based on the inclusion and exclusion criteria, recruited from investigation units for memory deficits and day-care centers for people with dementia in two urban areas in Sweden, in a collaboration between the research group and the professional personnel. Participants with AD had been diagnosed by physicians based on NINCDS-ADRDA (Mc Khann et al., 1984) and DSM-IV (American Psychiatric Association,

2000), and the participants with MCI had been diagnosed based on the diagnostic criteria for MCI (Petersen, 2004; Winblad et al., 2004). Information about diagnoses and up-to-date MMSE scores were gathered from the participants' medical files.

A group of persons with OA was engaged by the members in the research group through voluntary retirement organizations such as the Society of Retirees and similar networks. The members from the research group participated in meetings of the retirement organizations. In these meetings, verbal and written information about the project was given and contact with potential participants established. The OA group was included to be matched on a group level with their counterparts with AD or MCI regarding gender, age, and years of education, as these variables were expected to have impact on the ability to manage ET. The MMSE evaluation of this group was undertaken on the same occasion as the META observations and interviews. In total 192 persons were invited as participants. The final sample in Studies I and II consisted of 116 persons and the sample in Study III of 110 persons. In Figure 1, the inclusion and decline of participants in Studies I-III are described.

Figure 1. Inclusion and decline of participants in Studies I-III.



### *Participants in Study IV*

The participants in Study IV were 11 healthcare professionals working clinically with persons with dementia and their significant others. These participants were identified through different networks and associations for healthcare professionals working with persons with dementia and their significant others. A purposeful sampling (Maxwell, 1996) was used in order to provide richness in the data; variation in the participants' professions, types of professional area/setting, and working contexts (urban/rural) were sought. Also, as this pilot study aimed to investigate the applicability of a model and to explore how this model could be translated into healthcare practice, the participants needed to have the possibility to apply the knowledge and tools in the model within their settings. Finally, the participants needed to be willing to share their experiences and opinions in focus group interviews as well as in individual interviews. The recruited participants included five occupational therapists, one nurse, four assistant nurses, and one assistant officer. They worked in primary care, homecare services, hospitals, and in a community IT project. Both urban and rural working contexts in different parts of Sweden were represented. The 11 participants had in mean 15 years of experience of elderly care (range 1.5-30). For additional information about the participants, see Table 2.

### Data collection and instruments

#### *Assessment instruments, Studies I-III*

To observe and measure the ability to manage technology in everyday life such as cell phones, remote controls, and microwave ovens, *the Management of Everyday Technology Assessment (META)* was used. The META was developed to evaluate the ability to manage ET for older adults in general and in particular for people with mild dementia or MCI (Nygård, 2006), in order to facilitate provision of relevant individual support in ET management and to gain information useful for design and adaptation of ET. The META is based upon the Model of Human Occupation, MOHO (Kielhofner, 2008) and empirical results from an earlier study (Nygård & Starkhammar, 2007). According to MOHO, a person's ability to perform an occupation is made up of observable skills (Kielhofner, 2008). Also, as the performance is proposed to be affected by factors like values, interests, habits, and routines (Kielhofner, 2008), the assessments of the ability to manage ET are performed by observing the management

of the person's own, relevant, and currently used ETs. The qualitative and explorative study by Nygård & Starkhammar (2007) described the use of technology in everyday life for some older adults with mild to moderate dementia. The participants were observed and interviewed, focusing on their performance actions and their own reflections of the performance. This study resulted in taxonomy of difficulties and hindrances in the use of ET as observed and perceived in the participants' use of ET. These difficulties and hindrances then served as a base for the development of the performance skill items in the META. Using qualitative methods in the development of assessment instruments has been recommended by Gilgun (2004) and Morse, Hutchinson & Penrod (2003). Assessment instruments developed based on qualitative research can emphasize the clients' perspectives and incorporate their preferences and needs in the assessment (Gilgun, 2004; Morse et al., 2003).

The META consists of 17 items (for a description of the items, see Table 3), divided into three different constructs: 1) the person's observed *performance skills* (n=10 items) e.g. *identify and separate objects, coordinate different parts of a technology, and manage a series of numbers*, 2) the *intrapersonal capacities* (n=3 items) e.g. *the capacity to manage stress*, and 3) *environmental characteristics* (n=2 items) e.g. *the impact of the design*. Additionally, META includes two questions concerning the familiarity of the ET assessed (n=2 items: *how long* and *how often* the technology has been used). The observable performance skill items in the META assess the quality of the occupational performance when using ET. Examples of this include whether or not the person can identify and separate the cell phone from the remote control, choose the correct button or commando to make a phone call, or identify information on the cell phone screen and respond adequately. The performance skill items in the META are thought of as skills that are part of an occupational performance such as performing actions in logical sequence or coordinating different parts of a technology when using a micro wave oven (Kielhofner, 2008). The META performance skill items are related to underlying body functions (Kielhofner, 2008). However, the META is not developed to assess body functions but rather to evaluate the quality of how a person interacts with an ET in a context. The constructs intrapersonal capacities and environmental characteristics provide information about other aspects included in the management of technology. For these items, the rater's overall judgment of their impact on the person's ability to manage each ET is the base for the given score. An example of a question that the rater asks him- or herself concerning the impact of intrapersonal capacities could

be: how does this person's capacity to manage stress impact on his/her ability to manage his/her coffee machine? A question regarding the environmental characteristics could be worded like this: how does *the design* of a specific cell phone seem to impact the ability to manage it for a specific person? In Studies I and II, assessments of the 10 performance skill items of the person's observed performance skills were used in the analyses. In Study III, all 17 items in the META were analyzed.

The administration of a META assessment starts with a conversation with a set of pre-defined questions about the participant's interest in technology in general and specifically his or her ET related to everyday life. These questions are not included in the specific META assessment but are a part of the META administration, used to identify appropriate technological artifacts and services that are to be observed and assessed with the META. Thereafter, the participant is observed while using preferably at least three to four ETs (with a minimum of two ETs) of his or her own choice. The assessments take place in the participant's home or nearby, depending on which ETs to be assessed. The ETs assessed should be the participant's own, well-known, and currently used. Preferably, ETs sufficiently challenging, according to the hierarchy of ET difficulty based on the ETUQ are assessed (Rosenberg et al., 2009b). However, even if the raters should strive to observe ETs that are the most challenging of the chosen ones, the final choice of which ETs to assess is made by each participant. Also, for ethical reasons, the raters should aim to end the assessment session with an observation of an ET with a lower challenge for the participants.

The items in the META (except the familiarity items) are evaluated and scored for each ET, by a rater using a three-category rating scale; 3=no difficulty, 2=minor difficulty, and 1=major difficulty. For example, the categories in the rating scale for the performance skill item *identify and separate objects* in the assessment of how to manage a remote control could be illustrated thus: 3= Picks up the remote control without hesitation even though there is a calculator lying next to the remote control, 2= Picks up a calculator to turn on the TV but almost immediately notices that it is wrong and picks up the remote control instead, and 1=Mixes up the remote control and the calculator repeatedly and finally needs help to find the correct technology. The answers from the two items regarding the familiarity of the technology are sorted in five alternatives, respectively (*How long*: 0-3 months, 4-11 months, 1-2 years, 3-9 years, and 10 years or more. *How often*: daily, weekly, monthly, yearly, and less than yearly).

In addition, those who are assessed also report their own perceptions of their performances and abilities to manage the assessed ET. These perceptions are transformed by the rater into the three categories in the scale. For example if the participant reports that he or she sometimes forgets the password to the computer but always manages to log in by using a written reminder, the rater judges this according to the manual as 2=minor difficulty. If the rater has doubts in choosing between two scoring categories, the lower score should always be chosen based upon the assumption that if difficulties occur on the assessment session they probably occur on other occasions as well. When a performance skill item is not applicable to a particular ET, it is scored zero. To improve reliability and facilitate the use of the META, all raters receive a detailed manual with definitions of the items and the scoring criteria subsequent to their training to use during the assessment procedures (Nygård, 2006). The manual also contains detailed recommendations of how the assessment should be administered, as directed by the American Educational Research Association, the American Psychological Association, and the National Council of Measurement in Education (1999).

Table 3: Definitions of items in the Management of Everyday Technology Assessment

Performance skills	A1. Follow instructions given by automatic telephone services or answering machines A2. Choose correct button or commando A3. Identify services and function A4. Perform actions in logical sequence A5. Identify information and respond adequately A6. Manage series of numbers A7. Use appropriate force, tempo, and precision A8. Turn a button/knob in correct direction A9. Coordinate different parts of a technology A10. Identify and separate objects (artefacts)
Intrapersonal capacities	B1. Capacity to manage stress B2. Capacity to pay attention and focus B3. Capacity to recall necessary information
Environmental characteristics	C1. Contextual influence C2. Impact of the design
Familiarity	D1. How long the technology has been used D2. How often the technology is used

Key: Items A1 to A10 are observed and assessed by the rater. For items B1-B3 and C1-C2 their impact of the person's ability to manage for each assessed ET is evaluated by the rater based upon an interview with the person. Items D1-D2 are questions asked by the rater.

*The Mini Mental State Examination (MMSE)* (Folstein et al., 1975) is a widely-known and widely-used screening for examination of cognitive function. The MMSE contains 30 items divided into five areas: orientation, registration, attention and calculation, recall, and language. The MMSE is commonly used to detect suspected mild cognitive impairment or dementia (Mitchell, 2009). The maximum MMSE score is 30, which indicates normal cognitive functioning (Folstein et al., 1975). In clinical practice and in research different cut-off scores are used to separate different levels of cognitive impairment. Thus 20–24 indicates mild impairment, 15–19 indicates mild to moderate impairment, 10–14 moderate impairment, and <10 indicates severe cognitive impairment (Wlodarczyk, Brodaty & Hawthorne, 2004). In Studies I-III, MMSE scores of 18/30, 25/30, and 27/30, respectively, were used as cut-off scores for the three samples of older adults with mild AD or MCI and older adults without cognitive impairment (Fahlander, 2002). The MMSE scores were no more than six months old for all participants.

#### *A model to translate knowledge into healthcare practice, Study IV*

Study IV was aimed at investigating the applicability of a model to translate knowledge into healthcare practice. The content applied in this model was intended to aid healthcare professionals in advising and supporting the use of technology among older adults with dementia. It consisted of a one-day course and interviews (focus group discussions and individual telephone interviews) during and after a period of clinical tryout. The one-day course contained information about research findings concerning persons with dementia and their use of technology in everyday life. Additionally, in the course two clinical tools were presented. The first tool was a checklist (Rosenberg & Nygård, 2010) to aid healthcare professionals in their clinical work in supporting ET use and the process of providing ATs to older adults with dementia and their significant others (based on Rosenberg et al., 2011 and Rosenberg & Nygård, in press). The items in the checklist were not formulated as standardized questions but rather as advice to the healthcare professional such as *Note contrary needs and views between the person with dementia and his/her significant other* or *Find out what habit(s) of the person with dementia and his/her significant other the technology can be part of* (Rosenberg & Nygård, 2010). The second tool was the hierarchy of challenge of performance skills in the management of ET based on the META assessments in Study I (see Table 6). The focus group interviews (Morgan & Kreuger, 1997) were aimed at generating discussions reflecting the participants' views of how technology can be used by/for

persons with dementia and their significant others in everyday life, in relation to the knowledge. They were also seen as occasions to acquire information about the participants' views of the applicability of the knowledge and tools, which were thoroughly elaborated and discussed in detail. Focus group discussions are considered to entail a learning aspect (Dahlin-Ivanoff & Hultberg, 2006) and in this study it was believed that discussing and integrating the course material in focus groups could be a method of directly involving the participants in how to implement the knowledge and the tools in their work (Dewey, 1998). The individual telephone interviews were performed during the period of clinical tryouts. These telephone interviews were aimed at supporting the participants concerning the knowledge and tools as well as performing a short, open interview about their implementation of them.

#### *Data collection procedures, Studies I-III*

The data collection in Studies I-III was conducted during two years, 2006-2008, and took place in two urban areas in Sweden. Initially, written information about the study was sent to all potential participants. Shortly thereafter they were contacted by telephone and asked if they were willing to participate in the study. Those who agreed gave their verbal consent and a time for the assessment session was scheduled. The assessment session was performed in the participant's home or nearby, after written consent.

Next, the participant was observed while using a minimum of two ETs of his or her own choice, using the META. No maximum limit was set and in Studies I and II in mean 3.6 ETs for each person were assessed (range 2-10, SD 1.50). In Study III in mean 3.2 ETs were assessed for each person (range 2-7, SD 1.05). Furthermore, the participants were interviewed about their own perceptions of their performances and how they commonly managed when using the assessed ET. The performances on each of the META items and the participants' perceptions of their ability were thereafter scored by the rater on the three-category scale for each chosen technology.

Seven raters collected the data. The raters were all occupational therapists, experienced in working clinically with persons with dementia. Before starting to collect data using the META, all raters received a one-day training course including general information about the META and instructions of how to use the assessment. The raters were also educated about and trained in applying the scoring criteria of the

META (American Educational Research Association, the American Psychological Association and the National Council of Measurement in Education, 1999).

Additionally, after the education day the raters assessed the same four videotaped ET situations in order to have the opportunity to practice and discuss the scoring of the META. The raters each assessed, in mean, 16.6 participants (SD 13.6, range 1-34, median 18).

#### *Data collection procedures, Study IV*

The 11 participants gathered for a one-day course in the autumn of 2009. Besides the two course leaders, both experienced in the area of persons with dementia and their use of technology in everyday life, two assistants (one of them was CM) were present throughout the course day. The assistants took field notes and digitally recorded the discussions that spontaneously arose during the day. The day after the course, the participants were divided into two groups, and focus group interviews (Morgan & Kreuger, 1997) were undertaken. The focus group interviews were each led by one of the two course leaders, using a shared guide of themes to be discussed. Also, one assistant in each of the focus groups was present throughout the interview to digitally record the interviews, to follow the agenda, and take field notes.

Following the one-day course and the focus group interviews the participants were encouraged to consider and try to use the knowledge and the tools within their regular work during a period of six weeks. During these weeks, the participants were contacted once (n=2) or twice (=9) (due to practical reasons) by telephone. After the six weeks of clinical tryouts the participants gathered again in two focus group discussions to discuss their experiences and reflections regarding the tryout period. This time, both focus groups were led by the same person for practical reasons. Additionally, the distribution of the participants was different in this second round of focus group interviews for practical reasons, but this was also seen as a way to enrich data. Finally, following the second focus group interviews the participants were contacted for a second (n=2) or third (n=8) follow-up telephone interview. The participants themselves suggested this second/third round of telephone interviews and only one participant declined participation due to time constraints.

## Data analysis

### *Data analysis, Study I*

In Study I, the Rasch rating scale model was used to investigate the psychometric properties of the ten performance skill items in the META (Bond & Fox, 2007). As the META is used to assess a person's ability to manage ET using the performance skill items in the META, a many-faceted Rasch model was used to describe the linear relationship between the three facets. The basic assertions of the many-faceted Rasch model were expressed as follows in this study; (1) the more able a person is, the more likely it is that he or she will be able to pass harder performance skill items and ETs than will a less able person, (2) the easier the performance skill item and ET is, the more likely it is that it will be passed by all persons than will a harder item or ET, (3) persons obtain higher scores on less challenging performance skill items and ETs than on more challenging performance skill items and ETs and (4) persons with high ability achieve higher scores than persons with low ability. Using the many-faceted Rasch model, the response patterns from the persons were used to estimate each person's ability to manage ET. Assessed persons received a person ability measure (to manage ET) based on their responses to the 10 performance skill items in the META as well as their responses to the specific ET assessed. With the many-faceted Rasch model, the person ability measures can be estimated regardless of how many of the 10 performance skill items from the META that the person has been assessed on, or of which ETs are chosen, i.e. the measures are regarded to be test-free (Wright & Linacre, 1987). Furthermore, the performance skill items and ETs received measures of their relative challenges and the raters a measure of severity. The measures of ability and challenge were expressed in log-odds probability units (logits) on an interval scale (Bond & Fox, 2007). The raters were used as a fourth facet in the analyses. However, as the raters were not linked, i.e. they did not assess the same persons, it was therefore not possible to evaluate rater severity. So, the raters were assumed to be equally severe and they were anchored at the same rater severity in the analyses to allow for evaluation of rater stability.

To analyze the material, a computer application of FACETS (Version 3.61.0), a many-faceted Rasch analysis program (Linacre, 2006), was used. The initial step in the analysis was to investigate the rating scale functioning (Linacre, 2004). Three essential guidelines for rating scales to obtain measure stability and accuracy, described by

Linacre (2004), were used: (1) at least 10 observations of each category, (2) average measures advancing monotonically with category and (3) outfit *MnSq* less than 2.0. Besides measures of person ability, performance skill item challenge, and ET challenge, the FACETS analyses also generate goodness-of-fit statistics. Thereafter, the intra-rater reliability or stability was examined based on the hypothesis that they did not differ in severity.

Next, goodness-of-fit statistics were analyzed to evaluate the degree of fit between the observed responses in the material and the responses predicted by the Rasch measurement model (Bond & Fox, 2007). The goodness-of-fit statistics are presented in two mean square (*MnSq*) values and standardized *z*-values. They evaluate the assessed facets in relation to their fit to the Rasch measurement model and perform validity analyses of the constructed scales. The infit *MnSq* is weighted and associated to response patterns that are similar, e.g. person ability close to skill item or ET challenge. The outfit *MnSq* is not weighted and associated with response patterns that are unexpected and outlying sources (Schumacker, 2004). In order to get as much information as possible about the META, both infit *MnSq* and outfit *MnSq* were analyzed in this psychometric evaluation. For persons (person response validity), META performance skill items and ETs, an infit and outfit *MnSq*  $\leq 1.4$  (Wright & Linacre, 1994) associated with  $z < 2$  (Bond & Fox, 2007) were indicated as acceptable values. For raters, acceptable goodness-of-fit was set as outfit *MnSq*  $> 0.6$  and  $< 1.5$  (Engelhard, 1994). It is commonly accepted that 5% of the responses are expected to be misfits by chance (Bond & Fox, 2007). Acceptable criteria for goodness-of-fit were accordingly indicated by 95% of the persons, performance skill items, ETs, and raters respectively, showing goodness-of-fit. As the META only has 10 performance skill items, the goodness-of-fit criterion for internal scale validity was no more than one performance skill item demonstrating misfit (Kottorp, Bernspång & Fisher, 2003).

Additionally, all person, performance skill item and ET measures generated from the FACETS have error estimations, defined as Standard Error (SE). The accuracy of the measures is captured by the fit statistics while the SE indicates the precision of the estimated measures (Wright, 1995). Finally, the FACETS analyses generate person separation index and person reliability index. These were used to describe the reliability of the META for the assessed sample (Wright, 1996). The person separation index indicates how many groups of persons with statistically different

levels of ability can be identified in the sample, and the lowest recommended value for separating two groups is 1.5 (Fisher Jr., 1992). The person reliability index is interpreted correspondingly to Cronbach  $\alpha$ , and as in classical statistics an index of at least 0.70 was used as the lowest acceptable value (Streiner & Norman, 2003). A Cronbach  $\alpha$  value of 0.70 is described as satisfactory for comparing groups (Bland & Altman, 1997).

Due to administrative error, nine of the participants were removed from the analysis. These participants were not assessed on sufficiently challenging ET and received maximum score, and therefore valid person ability measures could not be estimated in the FACETS analyses (AD: n=1, MCI: n=4, and OA: n=4). Additionally, four participants were removed from the analyses as the number of ET assessments was not sufficient for those individuals. The final sample included 116 participants (see Table 2). Eleven out of the 79 assessed ETs were excluded from the analyses as no goodness-of-fit statistics could be estimated for them. The reason for this was that the participants who had been assessed on these technologies did not have any difficulties in using them, and the FACETS could therefore not estimate their level of challenge.

#### *Data analysis, Study II*

Study II was aimed at comparing the ability to manage ET among the groups of older adults (persons with mild AD and persons with MCI and OA), and the data analysis was performed in two stages. No significant differences regarding gender, age, and years of education were found between the groups using overall analyses of variance (ANOVA) with Bonferroni post-hoc tests and Pearson Chi<sup>2</sup> tests. First, the raw scores, i.e. the raters' scores in the META assessments, were converted into logits using the FACETS (Version 3.61.0) (Linacre, 2006). Second, to compare the person ability measures to manage ET between the groups, analyses of covariance (ANCOVA) were performed (Statistical Package for Social Sciences, Version 16, 2007). The dependent variable used in the ANCOVA analyses was the person ability measures generated from the FACETS analyses of the META. A forward selection procedure with an inclusion criterion of  $p < 0.05$  was used to examine the effect of covariates on the dependent variable. In this procedure, group was used as factor and age, gender, years of education and living situations (single or co-habiting) were used as covariates. Furthermore, in event of a significant main effect, the Least Significant Difference (LSD) post hoc test was used to determine between which groups person ability

measures were significantly different. The level of significance for these analyses was set as a  $p$ -value  $< 0.05$ . In addition, to investigate effect sizes for differences between the mean person ability measures for the three groups, Cohen's  $d$  were calculated (Cohen, 1988). An effect size is a measure of the strength of the relationship between two variables. A Cohen's  $d$  between 0.2 and 0.5 is considered a small effect, between 0.5 and 0.8 a moderate effect, and  $> 0.8$  a large effect (Dawson-Saunders & Trapp, 1994).

Furthermore, the raters' assessments of the participants' ability to manage ET based on observations and the participants' self-reported ability (transformed into numbers by the rater, using the three-category scale) were compared. First, the raw scores of the observations and the participants' self-reported ability were classified as follows: 0=no difference between a rater and a participant score, 1=rater scored one category higher than participant, -1=participant scored one category higher than rater, 2=rater scored two categories higher than participant, and -2=participant scored two categories higher than rater. Thereafter, differences in the raters' and participants' scores were visually presented using proportions (percentage) and compared group-wise.

### *Data analysis, Study III*

Study III was aimed at identifying aspects that influence the ability to manage ET among older adults with or without cognitive impairment. To begin with, a measure of person ability was estimated in FACETS version 3.61.0 (Linacre, 2006) for each person, based on the assessments of the 10 performance skill items in the META. These measures of person ability were then used as dependent variables in a linear regression analysis using a general linear model (GLM), ANOVA (Statistical Package for Social Sciences, Version 16, 2007). With ANOVA analyses it is possible to use categorical as well as metric data. The possible effect on the dependent variable was calculated for a number of independent variables, i.e. aspects. Of those, three were descriptive aspects ((1) diagnostic group, (2) gender and (3) (earlier occupation)) and three based on information from the META assessments ((4) intrapersonal capacities and (5) environmental characteristics and (6) familiarity). (See Table 4).

Table 4: Description of classification of independent variables.

<b>Independent variable</b>	<b>Type of variable</b>	<b>Classification</b>
Diagnostic group	Categorical	0=OA 1= MCI 2=AD
Gender	Categorical	Male or female
Occupation	Categorical	Blue- or white-collar (former or at present)
Intrapersonal capacities – central tendency	Categorical	Two classes of central tendency: Low or high median
Intrapersonal capacities – variation	Categorical	Four classes of variation 1. No variation 2. Low variation 3. Average variation 4. High variation
Environmental characteristics – central tendency	Categorical	Two classes of central tendency: Low or high median
Environmental characteristics – variation	Categorical	Four classes of variation 1. No variation 2. Low variation 3. Average variation 4. High variation
Familiarity – central tendency	Categorical	Two classes of central tendency: Low or high median
Familiarity – variation	Categorical	Four classes of variation 1. No/very low variation 2. Low variation 3. Average variation 4. High variation

To make the analysis practicable, the three META aspects were all analyzed in two different ways – central tendency and variation. For the central tendency, low or high median in the scores for all ETs assessed in each participant was calculated for each construct. For the variation, the variation within the scores for all ETs assessed in each participant (four classes of variation, 1=no variation, 2=low variation, 3=average variation, 4=high variation) was calculated for each construct. Hence in the ANOVA analyses nine independent variables were tested (see Table 4). Finally, in order to investigate differences between groups and classes of the independent variables, Bonferroni corrections were used to determine if the difference was significant, using a *p*-value of less than 0.05.

A backward selection procedure was conducted to remove the aspects not significantly associated ( $p < 0.05$ ) with the dependent variable in the final model of the ANOVA. However, the earlier defined variables (Study II), diagnostic group and gender, were included in the final model regardless of  $p$ -value. The backward selection procedure was chosen due to lack of earlier knowledge of the explorative META aspects' effect on ability to manage ET. To ensure that data fulfilled criteria for the model assumption, normal probability plots were applied. Furthermore, correlation analyses between the independent variables, i.e. aspects, were conducted in order to detect potential interactions. To reveal highly influential observations, Cook's distance was used.

#### *Data analysis, Study IV*

The material from the focus group interviews and telephone interviews was analyzed by a constant comparative approach using the principles of Grounded Theory (Charmaz, 2006; Glaser & Strauss, 1967). During the whole process of data collection, recordings from performed interviews were listened through in order to write memos and develop questions for the following interviews. Next, recordings of all focus group and telephone interviews were listened through to get an overall understanding of the material. Thereafter all focus group interviews and individual interviews were transcribed verbatim and inserted into the Open Code software program version 2.1 (Dahlgren, Emmelin & Winkvist, 2007) in order to facilitate the analysis by structuring the material. Memos were inserted into a separate text document.

After that, coding of the transcripts was conducted with focus on the participants' use and reasoning about the knowledge and tools and the potential and applicability of the model for translating the knowledge into practice. The codes were given names close to the data, i.e. close to the participants' own words. For example, a statement from one participant, "*so, to adjust the questions very much to suit a person you meet*" was coded as "*the new knowledge and tools – adjust to the person*". Throughout the process, the codes were constantly checked against the original data to make sure they were grounded in data. They also received descriptions to define their content and to separate them from each other. Parallel to the coding process, analytical memos were written and new questions were continuously raised, for which answers were sought in the data. Codes were then compared with each other to identify resemblances and differences, and then merged into categories. The constant comparisons continued

throughout the whole analysis process. During the period of analysis, codes, categories, and memos were discussed with and peer-examined by the last authors to increase validity of the findings. The analysis identified three categories, of which one contains sub-categories.

## FINDINGS

### Management of Everyday Technology Assessment (META) – Psychometric properties

The aim of Study I was to evaluate the psychometric properties (rating scale functioning, intra-rater reliability, internal scale validity, ET goodness-of-fit, person response validity, person separation, and reliability of the 10 performance skill items) in the newly developed assessment META used in assessments of the management of ET in a sample of older adults with and without cognitive impairment.

#### *Rating scale functioning*

The findings in Study I showed that the three-category rating scale (1=major difficulty, 2=minor difficulty, and 3=no difficulty) in the META is acceptable. The rating scale had at least 10 observations of each category, the average measures advanced monotonically (i.e. higher categories in the rating scale reflect more of the underlying variable with category) and the outfit *MnSq* was less than 2.0 for all three categories as specified by Linacre (2004). In Table 5 the counts and percentages of the categories in the rating scale are presented.

Table 5: Counts and percentages of the categories in the rating scale in the META.

Category	Count, n	%
1. Major difficulty	235	9
2. Minor difficulty	509	19
3. No difficulty	1947	72

#### *Intra-rater reliability*

All seven raters (100%) demonstrated acceptable goodness-of-fit to the Rasch measurement model and this indicated an acceptable consistency (intra-rater reliability) within raters (Bond & Fox, 2007). This finding was based upon the hypothesis that the raters were equally severe.

### *Internal scale validity*

As two of the 10 performance skill items, *manage a series of numbers/letters* and *coordinate different parts of a technology*, demonstrated an unacceptable goodness-of-fit to the Rasch measurement model, the META did not meet the set criteria for internal scale validity. The analyses of the 10 performance skill items resulted in a hierarchy of the items' levels of challenge (range 0.92 to -1.75, mean 0.00, SD 0.81, mean SE for all items 0.20). This hierarchy is presented in Table 6. The performance skill item at the top of the hierarchy, follow *instructions given by automatic telephone services or answering machines*, was the most challenging item for the sample of older adults with and without cognitive impairment. The performance skill item at the bottom, *identify and separate objects*, was found to be the least challenging.

Table 6: Map of performance skill item challenge and challenge measure (in logits).

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<b>More challenging performance skill items</b>
Follow instructions given by automatic telephone services or answering machines (0.92)
Choose correct button or commando (0.73)
Identify services and functioning (0.60)
Perform actions in logical sequence (0.49)
Identify information and respond adequately (0.33)
<i>Manage series of numbers/letters</i> * (0.10)
Use appropriate force, tempo, and precision (-0.41)
Turn a button or knob in correct direction (-0.45)
<i>Coordinate different parts of a technology</i> * (-0.56)
Identify and separate objects (-1.75)
<b>Less challenging performance skill items</b>

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\*= misfit according to criteria of goodness-of-fit to the Rasch measurement model.

### *ET goodness-of-fit*

All but three of the 68 (96%) ETs assessed with the META demonstrated acceptable goodness-of-fit to the Rasch measurement model. The ETs were, as performance skill items, hierarchically ordered from less to more challenging (see Table 7) and META

was concluded to be used in a valid manner to assess the management of ET using a wide range of ET challenge (range 1.60 to -1.82, mean 0.00, SD 0.87, mean SE for all ETs 0.50).

Table 7: Map of the 10 most challenging and the 10 least challenging assessed ETs and their level of challenge (measure in logits) among the 32 most assessed ETs.

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**More challenging ETs**

- Digital camera:** computer (1.55)
- Digital camera:** show pictures (1.25)
- TV:** video (1.11)
- Stereo:** tape recorder (0.93)
- Computer:** printer (0.79)
- TV:** DVD (0.74)
- Cell phone:** calendar (0.70)
- Computer:** write document (0.64)
- Cell phone:** check missed call (0.52)
- Cell phone:** SMS (0.50)



- Washing machine** (-0.37)
- Coffeemaker** (-0.70)
- Pushbutton telephone** (-0.72)
- Iron** (-0.73)
- Remote control:** TV (-0.87)
- Microwave oven** (-0.88)
- Shaver** (-1.00)
- Cell phone:** telephone book (-1.02)
- Electric kettle** (-1.22)
- Stove** (-1.82)

**Less challenging ETs**

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*Person response validity*

The measures of person ability represented a wide range of ability to manage ET (range 4.25 to -0.77, mean 1.56, SD 1.04, mean SE for all persons 0.49), from less to more able. Of the 116 participants, 113 (97.5%) demonstrated acceptable goodness-of-fit to the Rasch measurement model and it was indicated that the META demonstrates acceptable person response validity in this sample of older adults with and without cognitive impairment.

### *Person separation and reliability*

The person separation index of 1.68 indicated that the META can separate at least two groups with different levels of ability to manage ET. In Study II it was shown that META was able to separate three groups of older adults significantly from each other. The person reliability index of 0.74 indicated an acceptable replicability of person ability ordering. If the same sample of older adults with and without cognitive impairment were to be assessed on a parallel set of performance skill items representing the same construct, the person ability ordering would be essentially the same. For more detailed information of the analyses findings of the META, see Table 8.

Table 8: Summary of the evaluation of psychometric properties of the META (Study I)

<b>Analysis</b>	<b>Results of the analyses of the META</b>
Rating scale functioning	Acceptable, rating scale met the essential criteria.
Intra-rater reliability	Acceptable consistency within raters.
Internal scale validity	Not acceptable, 80% (8 of 10) of the items in the META met the criteria <sup>1</sup> .
ET goodness-of-fit	Acceptable, 96% (65 of 68) of the ETs assessed with the META met the criteria <sup>1</sup> .
Person response validity	Acceptable, 97.5% (113 of 116) of the persons assessed with the META met the criteria <sup>1</sup> .
Person separation and reliability	Acceptable, person separation index of 1.68 associated with a person reliability index of 0.74.

<sup>1</sup>Criteria of goodness-of-fit to the Rasch measurement model.

The internal scale validity is obviously a limitation of the current version of the META, and the performance skill items in the META therefore need further development and evaluation. However, as the analyses of the META demonstrated acceptable person response validity, it was concluded that the META still could generate a valid estimation of a person's ability to manage ET, person separation, and reliability, and thus these measures were therefore still used in Studies II and III.

## Older adults with mild AD, MCI, and OA and their management of everyday technology

Study II was aimed at comparing the ability to manage technology in everyday life assessed with the META among three groups of older adults – persons with mild AD, persons with MCI, and OA. The assessments were conducted in a context where technology was familiar and relevant to manage for the participant and the technology was the participant’s own. The results of the ANCOVA showed a significant main effect for groups ( $F [35.921], p < 0.001$ ). The findings further demonstrated in post hoc test that all three groups differed significantly from each other in ability to manage ET ( $p < 0.001$ ). Additionally, the findings showed that being a male increased the mean META measure of ability to manage technology in everyday life by 0.325 logits ( $p < 0.05$ ).

The ability to manage the technology was lower in the groups with mild AD or MCI than in the group with OA. Moreover, the group with MCI demonstrated a significantly lower ability to manage technology than the group with OA. Nonetheless, low ability to manage the technology was demonstrated in all three groups, and as shown in Figure 2, there were overlaps between the groups in ability to manage ET. Hence, it is not possible to deduce the individual ability to manage technology based solely on diagnosis. The effect sizes between the OA group vs. the AD group and the MCI group vs. the AD group were considered to be large, and the effect size between the OA group and the MCI group to be moderate (Dawson-Saunders & Trapp, 1994) (see Table 9).

Table 9: Mean measures of person ability to manage ET for each of the groups (adjusted for gender).

	Adjusted person ability measure (logits) Mean (SE)	Significance (Effect size, Cohen $d$ )	Mean difference (CI, 95%)
Mild AD	0.732 (0.133)	AD vs. OA $p < 0.001$ (1.87)	AD vs. OA 1.533 (1.174 - 1.891)
MCI	1.615 (0.144)	MCI vs. AD $p < 0.001$ (1.23)	MCI vs. AD 0.883 (0.496 - 1.271)
OA	2.264 (0.123)	OA vs. MCI $p < 0.001$ (0.66)	OA vs. MCI 0.649 (0.273 - 1.026)

Figure 2: Graph of group-wise distribution of unadjusted person ability measures.

---

Measure (logits)	OA (n=45)	MCI (n=33)	Mild AD (n=38)
4	*		
	*		
	*		
	**	*	
	***	*	
3		*	
	****	*	
	***		
	*	**	
	*****	*	
2	*****	***	
	****	**	**
	**	*	**
	****	****	*
	**	*****	****
1		****	***
	**	***	*****
	****	***	***
			**
		*	****
0			****
			*
			**
			**

---

Key: Every \* represents one individual. A higher measure in logits represents a higher ability to manage ET. Group-wise mean person ability measures: OA 2.24, MCI 1.65 and mild AD 0.73. Group-wise mean person ability measures adjusted for gender: OA 2.26, MCI 1.62 and mild AD 0.73.

### *Self-reported versus observed ability to manage ET*

In Study II the initial aim was also to examine the correspondence between the professional raters' observation-based evaluations of the participants' ability to manage ET, as well as the participant's own perception of his or her management ability. However, the findings of these analyses were not included in the original publication.

But as these findings can be interesting from a clinical perspective, they are presented here. The findings of the correspondence between the raters' observations and the participants' self-reports showed that self-reported ability in all groups corresponded to a great extent to the raters' assessment of the observed ability (see Table 10). However, self-reports of the OA group did demonstrate a higher correspondence with the raters' assessments than did the groups with MCI or mild AD. Visual inspection of Table 10 also shows that the OA group in general seemed to underestimate their ability to manage ET when compared to the raters' observations, while the group with mild AD in general seemed to overestimate their ability. The group with MCI tended to either overestimate or underestimate their ability to similar extent, in comparison to the raters' observations.

Table 10: Differences between the raters' assessments of the participants' ability to manage ET and the participants' self-reported ability.

	-2 Participant judged two categories higher than rater	-1 Participant judged one category higher than rater	0 No difference between rater's and participant's score	1 Rater judged one category higher than participant	2 Rater judged two categories higher than participant
Mild AD n assessments (%)	24 (3.5)	128 (19)	483 (72)	37 (5)	3 (0.5)
MCI n assessments (%)	16 (2)	85 (11)	568 (75)	84 (11)	10 (1)
OA n assessments (%)	9 (1)	60 (7)	721 (80)	113 (12)	0 (0)

Key: The participants' self-reported ability was transformed into numbers using the three-category scale in the META by the rater.

## Aspects influencing the ability to manage ET among older adults with mild AD, MCI, and no cognitive impairment

The aim of Study III was to identify aspects that influence the ability to manage ET among older adults with and without cognitive impairment. Three aspects were found to have a significant effect upon the dependent variable, the META measure of person ability to manage ET: (1) variation in the intrapersonal capacities (*the capacity to manage stress, the capacity to pay attention and focus and the capacity to recall necessary information*), (2) central tendency in the environmental characteristics (*the contextual influence and the impact of the design*) and (3) the diagnostic group. Comparisons between groups and classes of independent variables (using Bonferroni corrections) revealed significant differences between: a) mild AD and OA, b) no and average/high variation in intrapersonal capacities, and c) low and high central tendency in environmental characteristics. The final model of the analysis is presented in Table 11.

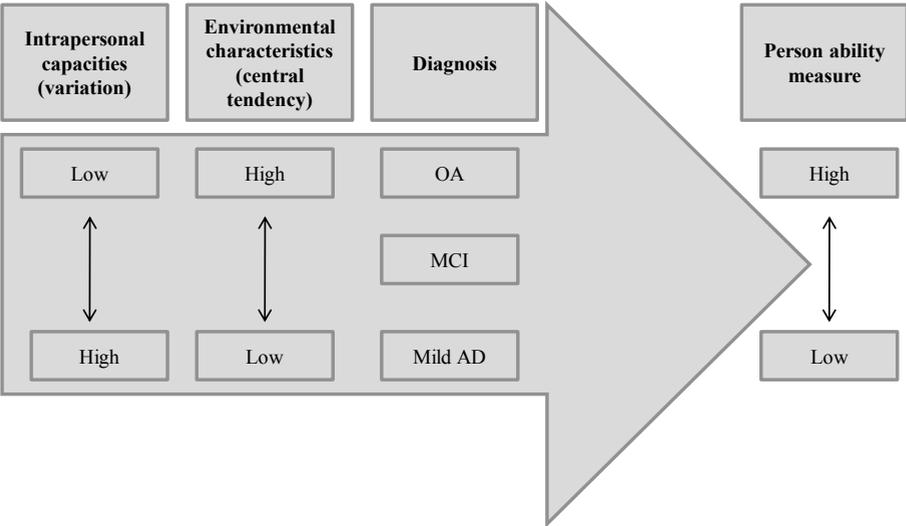
Table 11: Final model of the ANOVA with ability to manage ET as dependent variable. Variables were included with a backward selection procedure with an inclusion criterion of  $p < 0.05$ .

Effect	Comparison	Estimate	SE	95% CI		p-value
				Lower	Upper	
Diagnostic group <sup>1</sup>	0 versus 1	0.429	0.181	-0.011	0.869	0.058
	0 versus 2	0.840	0.195	0.364	1.316	<0.001
	1 versus 2	0.411	0.175	-0.015	0.836	0.062
Gender <sup>2</sup>	Men versus women	0.165	0.133	-0.099	0.430	0.218
Intrapersonal capacities – variation <sup>3</sup>	1 versus 2	0.436	0.192	-0.080	0.951	0.151
	1 versus 3	0.827	0.238	0.185	1.468	0.005
	1 versus 4	0.917	0.272	0.185	1.650	0.006
	2 versus 3	0.391	0.182	-0.098	0.881	0.203
	2 versus 4	0.482	0.217	-0.103	1.067	0.173
	3 versus 4	0.091	0.234	-0.540	0.721	1.000
Environmental characteristics – central tendency <sup>4</sup>	High versus low	0.566	0.150	0.267	0.864	<0.001

<sup>1</sup>Overall:  $p < 0.001$ . <sup>2</sup>Overall:  $p < 0.218$ . <sup>3</sup>Overall:  $p < 0.003$ . <sup>4</sup>Overall:  $p < 0.001$ .

These findings imply that high variation in intrapersonal capacities is negatively associated with the META measure of person ability; a person’s variation in the capacity to manage stress, to pay attention and focus and to recall necessary information affects the ability to manage ET. Finally, in Studies II and III it was demonstrated that the diagnostic group is associated with the META person ability measures to manage ET. In Figure 3, a schematic image of the influence of the significant aspects on the ability to manage ET is shown.

Figure 3: Aspects influencing ability to manage ET.



The final model (Table 11) of the analysis demonstrated an adjusted  $R^2$  of 0.517. Consequently, the variation in the intrapersonal capacities, the central tendency in environmental characteristics, and the diagnostic group explained 51.7% of the variation in the ability to manage ET. In Study II, the final regression model (including diagnostic group and gender) explained only 35.9%. Hence, adding the aspects of variation in intrapersonal capacities and impact of environmental characteristics will better predict a specific person’s ability to manage the technology in everyday life.

## Translating knowledge into clinical practice

Study I contributed new knowledge about how the ability to manage ET could be assessed among older adults with and without cognitive impairment. In Studies II and III, several aspects related to the ability to manage ET in the sample were described. However, how new knowledge of such issues could be translated into clinical practice in order to support the everyday life for persons with dementia still needs to be explored. Therefore, Study IV aimed at investigating the applicability of a model intended to support healthcare professionals, within their professions, to advise and support the management of technology among older adults with dementia. The model comprised a one-day course, including introduction and provision of two clinical tools, followed by interviews (focus group discussions and individual telephone interviews) during and after a period of practice. Study IV was also aimed at exploration of the process of how the model could be translated into healthcare practice. In the findings, three categories were identified.

As a starting point in application of the new knowledge and the tools into their work situations, the participants discussed *conditions influencing the readiness to take action toward supporting technology use*. These conditions included the healthcare professionals' approaches to the persons with dementia, such as getting information about the clients' own perceptions of their everyday life before initiating interventions. However, this was not always easy to achieve. In addition, supportive significant others and a well-functioning collaboration with other healthcare professions were important for the participants' readiness to support technology use among their clients.

Furthermore, the healthcare professionals' *incorporation of the knowledge and tools* was described. The healthcare professionals expressed an *ambiguity of technology* concerning AT and ET and their importance in everyday life for persons with dementia. Before the course their focus had been mostly on AT, but the knowledge and tools served as *an eye-opening experience*, and they explained how they now focused on ET use as well. A majority of the participants described a changed view of technology from the course and interviews. This view also came to involve their ideas of how to assess and support technology, applying the knowledge and tools provided. The tools were perceived as having the potential to act as a flexible base or model for them to observe and assess the use of technology among their clients. The healthcare

professionals reasoned about the knowledge and the tools as providing a *way of thinking*. They explained how they had acquired new ideas about technology which they could translate into practice within their professions.

In the third category, **confirmation and inspiration to new investigations**, the healthcare professionals described how they had had the opportunity to use the knowledge and tools in practice. In several ways the knowledge and tools were used as a facilitator for support and inspiration in their work with persons with dementia, regarding their use of technology. Moreover, the applicability of the knowledge and tools as a support for collaboration and communication with others (e.g. colleagues and significant others) was highlighted by healthcare professionals. The communication with other professionals using the knowledge and tools were considered to have a potential for improving their work and collaboration around the person with dementia. In conclusion, the model including a one-day course and clinical tools in combination with interviews during, and after a period of clinical tryout seemed to be an applicable way to translate knowledge produced in research into utilization in clinical practice.

## GENERAL DISCUSSION

The findings from the studies in this thesis have contributed new knowledge about the ability to manage ET among older adults with and without cognitive impairment. The thesis also contributed knowledge about how this ability can differ between groups of older adults and about aspects that may influence the ability. Furthermore, knowledge about how healthcare professionals can translate this knowledge into healthcare practice was contributed. The main findings will be discussed here as follows: 1) The management of technology in everyday life in older adults with and without cognitive impairment, 2) The Management of Everyday Technology Assessment, 3) Characteristics and challenge among META performance skill items and everyday technologies, and 4) Reflections on clinical use.

### The management of technology in everyday life in older adults with and without cognitive impairment

This thesis emphasizes the need for an increased focus on ET management among older adults with and without cognitive impairment. In Studies I-III it was demonstrated that older adults with and without cognitive impairment managed a wide range of ETs in everyday life and that low ability to manage the ET appeared for those older adults with, as well as for those without cognitive impairment. Concurrently, in Study IV it was shown that the healthcare professionals did not commonly consider ET in everyday life for their clients with dementia, and they described how the knowledge and tools used in Study IV provided them with *an eye-opening experience* and *a new way of thinking* regarding ET use. Use of ET and the ability to manage ET in everyday life is more and more important for the maintenance of autonomy, participation, and communication in contemporary society (Czaja et al., 2006; Jaeger, 2005; Mitzner et al., 2010; Mollenkopf & Kaspar, 2005; Slegers et al., 2007). This again implies that a significant issue in healthcare research and practice is to increase the knowledge about ET and ET management in older adults with and without cognitive impairment.

Findings from Study II demonstrated that the ability to manage ET differs in groups of older adults with and without cognitive impairment, and that assessments with the META could significantly separate three groups of older adults from each other. These

groups were persons with mild AD, persons with MCI, and OA. The group with mild AD was demonstrated to have the lowest ability, and the group of OA the highest. However, it is important to note that even though the findings in Study II pointed out significant differences between the three groups in ability to manage ET, low ability to manage ET appeared in all three groups and the differences presented appeared on a group level. There were overlaps in ability to manage ET between the three groups and a person with mild AD might accordingly have a higher ability to manage ET than a person with no known cognitive impairment. Nevertheless, in Figure 2 a possible cut-off score between the group with AD and the group with OA of approximately 1.4 logits could be observed. But due to the overlaps in ability and the fact that no exact thresholds in ability to manage ET were demonstrated between the groups in the findings, this cut-off score must be viewed with some caution and further research is recommended. As a consequence the level of ability to manage ET should, independent of diagnosis, always be individually considered.

Furthermore, in Study II the group with MCI demonstrated a significantly lower ability to manage ET, compared to the group with no cognitive impairment. However, the current criteria for MCI require an essentially intact ability to perform IADL (Petersen, 2004, Winblad et al., 2004). The findings in Study II correspond to recent studies where persons with MCI have been shown to differ in functional abilities like IADL in general and perceived difficulty to use ET, compared to persons without cognitive impairment (Jefferson et al., 2008; Kim et al., 2009; Nygård et al., 2011; Perneckzy et al., 2006; Rosenberg et al., 2009a; Tam, Lam, Chiu & Lui, 2007). Together with earlier studies, the findings in Study II support the discussion which suggests that the criteria for MCI may need to be reconsidered and revised (Kim et al., 2009; Perneckzy et al., 2006; Teng et al., 2010), although low ability to manage ET was not shown for all participants with MCI in the study. It has been recommended that decreased ability to perform complex IADLs such as managing finances and using the telephone and household appliances should be acknowledged in future MCI investigations (Artero, Petersen, Touchon, & Ritchie, 2006; Perneckzy et al., 2006). Instruments sensitive enough to detect such changes in persons with initial cognitive decline, as in MCI, have been requested (Bodine & Scherer, 2006; Hancock & Larner, 2007; Mariani et al., 2007; Nygård, 2003). Early detection of persons with MCI could open up for an adequate early intervention for the person with MCI and his/her family (Pedrosa et al.,

2010). Moreover, due to their increased likelihood of progression to dementia it is important to identify persons with MCI early (Petersen & Negash, 2008).

The findings in Study II, together with findings by Nygård et al. (2011) and Rosenberg et al. (2009a), show that ability to manage ET might be a domain of IADL sensitive enough to detect early cognitive changes, and could be used as a predictor of diagnosis. Assessments such as the META and the ETUQ are recommended for incorporation in the clinical evaluation of MCI to identify older adults at risk of developing dementia. Another reason to incorporate assessments of ability to manage ET in the clinical evaluation of MCI and early AD could be to identify those with lower ability who are at risk of exclusion from participation in everyday activities. As use of ET is important for participation in today's society (Czaja et al., 2006; Hickman, Rogers & Fisk, 2007; Slegers et al., 2007), knowledge of a person's ability to manage ET could be used to plan for interventions to support his/her ET use when needed. In addition, more longitudinal studies are needed to clearly disclose the diagnostic sensitivity of the META. In Study II, the participants with MCI probably represented all four sub-types of MCI, but the information of MCI sub-type for each individual was not available. In future studies of the ability to manage ET, knowledge of MCI sub-type would be valuable, as this has been shown to influence progression to dementia (Petersen & Negash, 2008).

In Study III, the findings showed additional aspects important for the ability to manage ET. Besides diagnostic group, variation in intrapersonal characteristics and the central tendency in environmental characteristics were found to be significantly associated with the ability to manage ET. When these additional person-oriented aspects were added, the differences between the OA group and the MCI group as well as between the MCI group and the AD group were no longer statistically significant as in Study II. Accordingly, the findings in Study III showed that besides diagnosis there seem to be other person-oriented aspects that could affect ability to manage ET, such as the capacity to manage stress and the capacity to pay attention and to focus. The findings highlight the importance of taking these intrapersonal capacities as well as the environmental characteristics into account in ET management in older adults. Moreover, the findings in Study III suggested that the variability in intrapersonal capacities seems to be of more significance than the level of intrapersonal capacities in relation to the ability to manage ET for older adults with or without cognitive

impairment. Thus, a *high variability* in the capacity to pay attention and to focus influences the ability to manage a cell phone more negatively than the *level* of the capacity to pay attention and to focus. Performance variability has previously been shown to be an indicator of cognitive decline and a probable marker of change in cognitive ability (Bielak, Hultsch, Strauss, MacDonald & Hunter, 2010; Gorus, De Raedt, Lambert, Lemper & Mets, 2008; Holtzer, Verghese, Wang, Hall & Lipton, 2008; Lövdén, Li, Shing & Lindenberger, 2007). Hence, it has been suggested that variability in ability should receive more attention in clinical investigations (Lövdén et al., 2007). The findings in Study III imply that in assessments of the ability to manage ET, is important to consider not only a person's intrapersonal capacity but also the variability in intrapersonal capacities. To capture this variability in the ability to manage ET, studies with a more longitudinal design could provide new insights.

The findings in Study III also showed the importance of environmental characteristics in the assessments of ET management. The more environmental characteristics such as the contextual influence and the impact of the design interfered in the performance on ET management, the more negatively it influenced the ability to manage ET. Consequently, ET needs to be considered both as a potential support and as a hindrance when performing everyday occupations (Rosenberg, 2009). As persons differ in abilities and beliefs in their own abilities, a specific environment can present several hindrances to one person but none to another person (Kielhofner, 2008). Regarding management of ET, this could be exemplified in a person standing in a line in front of a cash machine with the intention to get some cash. For a person with cognitive impairments this situation could lead to difficulties, such as coping with the stress of having another person behind while handling the cash machine as required to get the right amount of cash. Another person might not even have thought about the line in relation to the ability to manage the cash machine. For the person with cognitive impairment this situation might be eased by trying to use the cash machine when there is no line. Considering the contextual influence is hence important for those who aim to assess and support the management of ET for older adults with and without cognitive impairment. As AD is a degenerative disease and persons with AD are not expected to increase in competence to meet the environmental constraints, the supportive features of the environment may be of particular importance (Giovannetti et al., 2007). In addition, it is of great significance to consider potential hindrances for persons with

dementia or MCI in the societal environment, such as using Internet-based healthcare services (Rosenberg, 2009).

The impact of the design of the ET itself was also shown to influence the ability to manage ET. Objects, for example ETs and the specific properties and design of them, have been proposed to strongly influence occupation (Kielhofner, 1995; Kielhofner, 2008). It has been recommended that when designing ETs for persons with dementia or MCI, the ET preferably should signal how it is to be used and also require minimal user initiation (Rosenberg, 2009). ETs with a more user-focused design might have the properties to facilitate and support the management of ET (Lewis, Langdon & Clarkson, 2008), and this may in turn support social activities and simplify performance of everyday activities for older adults with and without cognitive impairment (Orpwood et al., 2007; Sixsmith, Gibson, Orpwood & Torrington, 2006). The META performance skill item hierarchy could be used to guide the design of ET as well as being a tool in clinical practice (Study IV), which will be further discussed in the “Reflections on use” section.

The final model in the findings of Study III demonstrated that the variation in intrapersonal characteristics, the central tendency in environmental characteristics, and the diagnostic group explained 51.7% of the variation of the ability to manage ET. Consequently, a considerable part of the ability is not explained by this model, and a person’s ability to manage ET is also dependent on a variety of other aspects. In the assessments with the META, an important point of departure was the familiarity of the ET. The ETs assessed were therefore to be relevant, self-chosen, and currently used by the person. Nevertheless in Study III, familiarity (i.e. how often and for how long) did not fall out as an influencing aspect for the ability to manage ET. The explanation of this was probably that in the assessments with the META the inclusion criteria excluded ETs that were not relevant to the person or too seldom used. The ETs chosen as relevant were most likely regularly used and incorporated in everyday life, i.e. often used for a long time. Also, how often and for how long a person has used a specific ET is only one aspect of familiarity. Familiarity can also include a person’s habits, and those are explained to influence how routine activities are performed (Kielhofner, 2008). Accordingly, even if the aspects of familiarity explored in Study III did not significantly influence the ability to manage ET, considering familiarity aspects when assessing the ability to manage ET is important in general.

To conclude, as the ability to manage ET is essential to maintaining everyday activities and participation in society, it is important to assess and support the ability. In the findings it was shown that the ability to manage ET differs significantly between older adults with mild AD, MCI, and no known cognitive impairment. Besides diagnosis, variation in intrapersonal capacities and environmental characteristics like context and design are crucial to consider in assessments of ET management. In future evaluations of ET management in older adults, different situations and circumstances need to be taken into consideration in order to detect potential problems, as it cannot be assumed that a person's performance capacities presented in one context or situations are representative for him or her in other contexts or situations. Additionally, it is of great importance to advise healthcare professionals about how to assess and support the ability to manage ET in older adults with and without dementia.

## The Management of Everyday Technology Assessment

In Studies I-III the META was used to assess the observed ability to manage ET in older adults with and without cognitive impairment. The aim of the META is to identify the ability to manage ET in older adults in general, and specifically in persons with mild AD or MCI. In Studies I and II, the psychometric properties of the META were examined as used in a sample of older adults with and without cognitive impairment, using a Rasch rating scale model. In the findings of these studies both strengths and limitations of the META were exposed.

First, in Study I it was shown that the META has acceptable person response validity. The participants demonstrated acceptable goodness-of-fit to the Rasch measurement model; independent of diagnosis and which ETs and performance skill items assessed the response pattern among the sample was stable. This indicates that META can be used in assessment of the ability to manage ET for older adults with and without cognitive impairment in a valid manner (Fisher, 1994). If META were to be used to assess an equivalent sample, a similar hierarchy of person ability would be expected. The ordering of the person ability hierarchy presented in Study II was expected, based on earlier knowledge (Nygård et al., 2011; Rosenberg et al., 2009a), with mostly persons without cognitive impairment at the top of the hierarchy and mostly persons with mild AD at the bottom. The META was also, in Study II,

shown to significantly separate three groups of older adults from each other. However, as earlier mentioned, there are overlaps in ability between the three groups, and these could be an indication of the rather low person separation index found in Study I for the META in this sample. That is, the META has a moderate ability to separate individuals with different levels of ability to manage ET. Still, the person separation index of 1.68 is higher than the lowest recommended index of 1.5 (Fisher, Jr., 1992), but this rather low person separation would be of major concern if the META were to be used to evaluate the effects of interventions regarding ET management on an individual level. Low separation indices have earlier been found in other assessments assessing performance in everyday activities (Doble & Fisher, 1998; Petersson et al., 2007). With a low person separation, it could be difficult to detect individual changes in the ability to manage ET assessed with the META.

One aspect that could have negatively influenced the person separation is the homogeneity in the sample (Bond & Fox, 2007); the individuals in the sample might not have differed enough in ability to manage ET and therefore person ability measures did not have a sufficiently wide range. However, the separation is expected to increase if the META were to be applied in a more heterogeneous sample (Bond & Fox, 2007), and further research with a more diverse sample is therefore indicated. This means the participants need to have greater variation in ability to manage ET to increase the person separation on the assessed construct.

Another aspect that might have reduced the person separation could be that the challenge of performance skill items and ETs were not targeted to the ability of the persons in the sample. The measures of performance skill item and ET challenge were generally lower than the measures of person ability (see Table 6, Table 7, and Figure 2). This means that META may not easily discriminate between individuals with high ability to manage ET because there are few performance skill items and ETs targeting their ability. A similar result was found by Nygård et al. (2011) and Rosenberg et al. (2009b) when using the ETUQ to assess the perceived relevance and perceived difficulty in using ET in a sample of older adults with and without cognitive impairment. On the one hand, the META and the ETUQ were specifically developed for use among persons with cognitive impairment or dementia and those individuals were the ones best targeted to performance skill items and ETs. On the other hand, to increase the person separation index for the META, more challenging performance skill items and assessments of the management of more challenging ETs may need to

be added (Linacre, 1995). Therefore in future evaluation of the META, more challenging performance skill items need to be added. In addition, raters need to be even more attentive to targeting ETs of sufficient challenge for each participant. As only the performance skill items in the META are mandatory to use in the META assessments and the ETs are chosen by the persons themselves, new ETs can be included in the META assessments as long as they fit the Rasch measurement model. This must be seen as a strength regarding the increase in technology use in today's society. Assessments with the META could accordingly be used to assess the ability to manage ETs relevant to the person, in spite of a constant technological change.

A third explanation for the low person separation could be the relatively large SEs for person ability (mean SE 0.49) and ET challenge (mean SE 0.50). The person separation index is known to be connected to SEs (Bond & Fox, 2007). The sizes of the SEs in the findings in Study I seem to be caused by a lot of ETs being used by only a few participants, and this resulted in difficulties estimating the precise level of challenge for those ETs and in turn generated large SEs for the person ability measures. To decrease the SEs and increase the person separation index in future studies, all persons need to be assessed on more ETs and ETs need be assessed by more persons.

In Study I, the META also demonstrated both acceptable ET goodness-of-fit and acceptable rating scale. However, due to unacceptable item goodness-of-fit for two performance skill items, the META did not meet the criteria for acceptable internal scale validity. This illustrates a plausible limitation of the META, and thus there is a need for further psychometric evaluation and a revision of the META performance skill items. The performance skill items that did not meet the criteria for acceptable goodness-of-fit to the Rasch measurement model were *manage a series of numbers/ letters* and *coordinate different parts of a technology*. The unacceptable goodness-of-fit to the Rasch measurement model for the performance skill items *manage a series of numbers/ letters* and *coordinate different parts of a technology* indicated unexpected responses. These could be explained by unexpected responses from some of the assessed persons, and an investigation of the most unexpected responses in the data revealed lower scores than expected by the Rasch measurement model. This could either be due to an unexpected ability in some of the participants or to ambiguous wording of the items, which could make it difficult for the raters to make accurate

assessments (Wright, 1991). Items with unacceptable goodness-of-fit are common, for example, in the development of the AMPS, where some of the items were demonstrated to have an unacceptable fit to the Rasch measurement model. These misfits were related to unexpected responses and were in subsequent evaluations of the AMPS improved by additional information to the raters (Fisher, 1994). Thus in future use of META, the wording of the performance skill items needs to be considered, and META raters may also need more thorough information about the items.

Besides revision of wording and description of the existing performance skill items in the META it might, in future use, be constructive to divide the items of *manage a series of numbers/letters* and *coordinate different parts of a technology* into two items each to make assessments of them more accurate. *Coordinate different parts of a technology* could be divided into two items – one describing more hands-on coordination of different parts of a certain technology such as putting CD in the stereo, and one assessing more abstract coordination like using a mouse to the computer to navigate on the screen. *Manage a series of numbers/letters* could also be divided into two items – one assessing the management of telephone numbers and one the management of codes of different kinds. In addition more items could be included in the META. In assessments with the AMPS, persons with dementia have demonstrated increased difficulty with the motor skill “paces” (Oakley, Duran, Fisher & Merritt, 2003). To gain more focus and point out the importance of the pace in the ability to manage ET in the assessments with the META, the performance skill item of *use appropriate force, tempo and precision* could be divided into *use appropriate force and precision* and *use appropriate tempo*.

Finally, it was shown that the 3= no difficulty category was used in 72% of the assessments (see Table 5). To make the assessments with the META more precise, one suggestion could be to divide category 3 into two different categories. In the APMS, four categories are used – competent, questionable, ineffective, and deficit (Fisher & Jones, 2010). The questionable category is used when the rater has a sense of uncertainty regarding the person’s ability (Fisher & Jones, 2010). To use such a four-category rating scale in the META may increase specificity of measures generated by the META and also make META easier to use clinically. With an additional category in the rating scale, META might give more detailed information about the management of ET and therefore be able to better guide interventions.

## Characteristics and challenge among META performance skill items and everyday technologies

The findings of Study I produced three hierarchies, one showing the level of challenge for the ten performance skill items in the META (also used as one of the tools in Study IV), one the level of challenge for assessed ETs, and one the ability to manage ET among the assessed sample (discussed in the management of ET section). As earlier described, SEs for ET challenge and person ability were relatively large, but larger studies might estimate the level of challenge and ability more precisely (Bond & Fox, 2007). Despite these plausible imprecisions of the hierarchies, the hierarchies of performance skill items and ETs will be discussed here.

Examining the hierarchy of performance skill item challenge (see Table 6) for the assessed sample, the least challenging performance skill items – *identify and separate objects, coordinate different parts of a technology, and turn a button or knob in correct direction* – seem most often to require more physical ability than the most challenging – *follow instructions given by automatic telephone services or answering machines, choose correct button or commando, and identify services and functioning*, which require more cognitive ability. This is comparable with the hierarchy of skills in the AMPS, where process skills generally are shown to be more challenging than motor skills for older adults without cognitive impairment as well as for persons with dementia (Doble, Fisk, MacPherson, Fisher & Rockwood, 1997; Robinson & Fisher, 1999). Furthermore, in assessments with the AMPS, persons with dementia have been demonstrated to have more difficulties in skills concerning *knowing how* to do (such as using and handling objects) than in skills related to *knowing what* to do (such as finding and choosing correct objects and performing the task specified) (Cooke, Fisher, Mayberry & Oakley, 2000). This seems to be in line with the performance skill item challenge in the META. However, in analyses of the META items, the challenge of items was analyzed for the whole sample and not for each group. In further studies, it would be interesting to perform differential item function analyses to gain information about how the performance skill items in the META function in the three sample subgroups.

In MOHO three types of skills used in performance are defined: motor skills, process skills, and communication and interaction skills (Kielhofner, 2008). When using ET, it

could be argued that all three types of skills are needed. However, the person-to-person communication and interaction may differ from the person-to-technology communication and interaction. One example is to understand the meaning of a text commando that comes up on the computer screen and act in accordance with that commando; that could be assessed with the META performance skill item *identify information and respond adequately*. This could maybe be explained as a skill of different quality than the skills described in the MOHO. To clarify this, more studies are needed to evaluate the relation between skills used in the META and motor, process, and interaction skills. Adding to this complexity, the concept of digital literacy or digital skills, i.e. skills that are required in order to perform in digital environments, is sometimes used (Eshet-Alkali & Amichai-Hamburger, 2004). However, digital skills mostly refer to ICT use and not a more general ET use. Digital skills concern skills such as to search the Internet or how to identify irrelevant information on the Internet (Eshet-Alkali & Amichai-Hamburger, 2004), and those may not be useful when assessing ET use in general as they so specifically assess computer use.

In the AMPS, the items are divided to assess process skills and motor skills as different constructs (Fisher & Jones, 2010) while in the META, all items currently are assessed as one construct. The items in the META could to some extent be compared to the items in the Assessment of Computer-Related Skills (ACRS), which has items adapted from motor as well as process skills from the APMS. ACRS is used to assess computer-related skills and tasks. In an evaluation of the items in the ACRS, all of the items appeared to belong to one single construct of computer-related skills (Fischl & Fisher, 2007). However, additional studies are needed to further investigate which construct or constructs are assessed with the performance skill items in the META as compared to the ACRS.

Furthermore, the most challenging performance skill items in the META (*follow instructions given by automatic telephone services or answering machines, choose correct button or commando, and identify services and functioning*) could also be described as more complex than the least challenging (*identify and separate objects, coordinate different parts of a technology, and turn a button or knob in correct direction*) in the sense that they often include a chain of skills to perform (Fischl & Fisher, 2007; Nygård, 2006). For example, to correctly identify, have knowledge about, and use the “save function” in the computer (*identify services and functioning*)

appears more complex than to turn a button on a shaver in the correct direction (*turn a button or knob in correct direction*). Related findings were described by Lewis, Langdon and Clarkson (2008) when they compared the use of two microwave ovens with different user interface control panels, one with a two-dial interface (where the user needs to turn the dial in the correct direction) and the other with a 15-button interface (where the user needs to first identify and then use the correct button). The comparison illustrated that the microwave oven with a dials interface was found to be obviously easier to use than a buttons interface microwave oven for older adults with cognitive impairment as well as for younger adults. This was explained by the larger number of buttons on the buttons interface, which in turn required more actions from the user (Lewis et al., 2008). The correlation of the complexity of the items in the management of ET and the difficulty of the ET was also shown by Patomella and co-workers (submitted).

The five most assessed ETs with the META were *cell phone – call*, *TV*, *microwave oven*, *computer – e-mail*, and *cell phone – send text message*. This could be compared to the findings in a study of experience of and relation to technology in the everyday lives of the oldest old (85 years or older). In that study the TV, the radio, and the telephone were the ETs most spontaneously mentioned when talking of technology in everyday activities. Additionally, the microwave oven and the coffee machine were mentioned, but then in relation to an activity such as cooking (Larsson, 2009). In the sample of Studies I-III in this thesis, though, with a mean age of 73 years, the management of the cell phone was more often assessed than the management of an ordinary telephone. However, the assessments with the META were performed on ETs relevant to the persons and not necessarily the most commonly used. When comparing the findings to the ETs perceived as the most and least relevant for a sample of older adults with and without cognitive impairment, assessed with the ETUQ (Rosenberg et al., 2009b), some differences can be detected. First, among the ten ETs perceived as the least relevant with the ETUQ both *cell phone – send text message* and *internet* are found. Second, among the ten ETs perceived as most relevant with the ETUQ, only *TV* is also among the five most assessed ETs with META. The reason for these differences might be that the data collection for the ETUQ study was conducted some years before the data collection with the META. This may also be an indication of an increased use of new technology over time, and it again demonstrates the strength in META, having the opportunity to include the management of new ETs.

Regarding the level of ET challenge (see Table 7), the findings in Study I demonstrated that for this sample of older adults ETs like *cell phone*, *DVD*, and *digital camera* generally were more challenging than *stove*, *electric kettle*, and *shaver*. One explanation for these findings could be the influence of familiarity on ET management in a wider sense than how often and for how long the ET has been used. Habituation such as the person's habits and roles has been described to have an influence on performance of everyday occupations (Kielhofner, 2008). Hence, the findings might be explained by the fact that the least challenging ETs were incorporated to a greater extent in daily routines than were the more challenging, as earlier described by Larsson (2009). One way to maintain use and routines unchanged could be to not obtain new technology, for example to continue to use an ordinary telephone instead of getting a cell phone (Larsson, 2009). Moreover, ETs that are used seldom have been demonstrated to be more difficult to manage than ETs more frequently used (Nygård, 2008; Patomella et al., submitted). Frequent use in combination with motivation and an experienced need could sometimes be more important than familiarity and habits (Nygård, 2008). It is again important to note that the findings in Study III demonstrated that the familiarity of a technology, i.e. how often and for how long ETs are used, do not significantly correlate with a person's ability measure to manage ET. But as earlier mentioned, this finding might correlate to the design of the META assessment procedures and the definition of familiarity. Further studies are needed to examine level of ET challenge and its correlation to familiarity.

## Reflections on clinical use

The clinical rationale for the need of knowledge of a person's ability to manage ET is to facilitate for healthcare professionals such as occupational therapists to provide relevant individual support to persons with low ability to manage ET. The in-depth knowledge about the ability to manage the ET among older adults with and without cognitive impairment collected through the META observations and interviews could provide a base for supportive interventions and for developing strategies to support everyday activities (Giovannetti et al., 2008) in which technology is required. In addition, the META could be used as a complement to ADL and IADL assessments. Even though management of ET targets a current and rapidly changing area influencing most people's everyday lives, it is usually not considered in existing ADL

and IADL assessments (Ala et al., 2005). Information from the META hierarchies of performance skill item and ET challenge could also be useful for design and adaptation of ET, as exemplified in Study IV. However, this needs to be further evaluated in empirical research. The META could be seen as a flexible assessment that can be adjusted for changes in IADLs and in society resulting from ET use and development, as it is possible to include new performance skill items and new ETs as long as they fit the Rasch measurement model (Bond & Fox, 2007). Considering temporal dimensions of person-environment interactions in occupation has also been suggested by others (Scheidt & Norris-Baker, 2003). Finally, the META takes into account the intrapersonal capacities and environmental characteristics, which in Study III were shown as important for ability to manage ET in older adults. The importance of the interaction between a person's capacities and the environment where the occupation takes place has been theoretically proposed by Kielhofner (2008). However, Study III contributed a more dynamic view of the person-environment interaction, as not only a person's capacity but also the variability in intrapersonal capacities is important to consider. The variability in intrapersonal capacities in the management of different ETs underscores the complexity in the person-environment interaction. The difficulty of regarding the person and the environment as separate components has earlier been highlighted. (Dickie et al., 2006; Law et al., 1996; Scheidt & Norris-Baker, 2003).

Another aspect influencing ability to manage ET could be the person's motivation to use the specific ET. Motivation is known to influence the performance of everyday occupations (Kielhofner, 1995; Kielhofner, 2008), and it has explicitly been described that motivation is important for a continued use of ET among persons with dementia (Nygård, 2008). Nevertheless, Larsson (2009) found that high motivation to acquire new ET was not always enough to allow learning how to handle it. Regarding assessments with the META, a person's motivation to use a specific ET might be difficult to assess, but in interventions to support ET management the motivation may be significant to emphasize. Acknowledging aspects like habits, strategies, and personal preferences is also important for ET as well as AT use (Rosenberg, 2009). The advice to healthcare professionals in the checklist used in Study IV (Rosenberg & Nygård, 2010) underlines aspects like these to support use of technology for older adults with dementia.

In Study IV the healthcare professionals did not use the META assessment, but they did use the META hierarchy of performance skill and the checklist (Rosenberg & Nygård, 2010) as part of a model for knowledge translation. These tools were more flexible in use than a strict assessment (such as the META), as the healthcare professionals themselves, by integrating the knowledge and tools into their own practice, could decide how and when to apply them. This approach was based on Dewey's ideas (1998), and the healthcare professionals explained that the knowledge and tools provided them with "*a way of thinking*". The healthcare professionals verified the potential use in clinical practice in trying out and explaining how the META hierarchy of performance skill items in combination with the checklist could be used in interventions to detect, assess, and support technology management among older adults with dementia. These findings of potential use suggest that the healthcare professionals found the knowledge and tools clinically relevant for them. This has earlier has been proposed as a facilitator for translation of research into practice (Baumbusch et al., 2008; Hutchinson & Johnston, 2004). However, it would be interesting to further examine what this "*way of thinking*" implies and also how the knowledge was translated into "*a way of thinking*". The knowledge and tools were also described to facilitate collaboration with other groups of healthcare professionals. For example, they found that the detailed information from the META hierarchy of performance skills could be used to explain in detail difficulties in technology management among their clients to colleagues or significant others. Support from colleagues has previously been shown to facilitate research utilization (Hutchinson & Johnston, 2004). These findings underscore the importance of including clinicians in the evaluation of how research knowledge can be used in clinical practice as a part of the establishment of evidence-based practice.

The importance of taking the clients' perceptions into consideration in interventions has been discussed earlier (Fisher & Jones, 2010; Kielhofner, 2008). The checklist (Rosenberg & Nygård, 2010) used in Study IV, developed to aid healthcare professionals to support ET and AT use for persons with dementia, was thought of as a support for healthcare professionals in this respect. The items in the checklist were not standardized questions but rather open and flexible pieces of advice that were to be used based on the contexts and preferences of the healthcare professionals. A more restrictive checklist may not have allowed for the healthcare professionals to take their clients' experiences, wishes, and needs into account (Klein, Barlow & Hollis, 2008). This flexibility of the checklist was shown to be important for the users, and they even described a wish for more flexibility. Supporting healthcare professionals

in such flexibility and at the same time translating research knowledge into clinical practice also requires a flexible approach. Such an approach can be maintained through Dewey's ideas (1998), where it is proposed that learning needs to be purposeful and connected to the reality of the learners. Also, in this approach, an active involvement in learning to make the knowledge one's own is important. The model inspired by Dewey's thoughts on learning (1998) used in Study IV was shown to be an applicable way to translate research into utilization in practice. Models like this require a greater effort from both researchers and practitioners than, for example, oral presentations of the research or lectures on the subject. However, learning in a more static way, such as achieving knowledge in the form of a finished product without taking experiences and reality of the learners into account, has been criticized (Dewey, 1998). To enhance evidence-based practice, this model for knowledge transfer may be a form for how the knowledge gained in research could be translated into practice.

An important issue in clinical practice is the choice of assessment method – self-report or observation – and much can be said about this choice. The findings of the visual comparisons of the participants' self-reported ability and the raters' assessment of the observed performance to manage ET using the META were mostly in accordance with previous studies of self-reported ability among older adults with and without cognitive impairment. As expected, the group of persons with mild AD tended to overestimate their ability to a higher degree than did the group of persons with MCI or the group of OA, as earlier described (Farias, Mungas & Jagust, 2005; Tabert et al., 2002). Our comparisons showed that the group with MCI over- and underestimated their ability to the same extent when visually compared to the observation-based ratings. A few earlier studies have indicated different findings concerning ability to self-report everyday functioning in people with MCI, but these differences may derive from differences in design of the studies. The findings in this thesis are in line with Onkonkwo and colleagues (2008), who also compared self-reports to observations and found people with MCI to both over- and underestimate their ability compared to observation-based rating. Farias et al. (2005) who, on the other hand, compared self- and informant-rated functional ability, did report people with MCI to be no more discrepant in self-reports compared to informant reports from healthy older adults. It must be underscored, though, that the findings in this thesis showed that generally in all groups there were no differences between raters' and participants' scores (mild AD 72%, MCI 75%, and OA

80%). A majority of the participants judged their levels of ability to be the same as the rater did. This calls for careful consideration when making assumptions about the perceptions of persons with AD or MCI regarding their self-reported ability. However, it must be emphasized that it is important to include self-reports as a complement to observations in order to provide interventions considering the clients' perspectives as well (Öhman, 2007).

The differences between a participant's self-reported ability and a rater's assessment of the observed performance might in some cases in the findings in this thesis depend on the fact that the rater and the participant assessed two slightly different things. The rater assessed the observed, present performance of the management of the ET, and the participant rated his/ her perceived performance as well as how they commonly managed the assessed ET, based on clinical reasons (Nygård, 2006). However, the motive for including a participant's self-reported ability and a rater's assessment of the observed performance in an assessment such as the META was, as suggested by Ejlersen Wæhrens (2010), to provide the rater with as much knowledge as possible and not to obtain the same information in the observed and the self-reported performances. From a clinical perspective, the healthcare professionals in Study IV supported this approach as they emphasized the importance of getting information about their clients' own perceptions of their everyday lives before initiating an intervention. If a person does not perceive that he/she is having problems in everyday occupations, this would influence on how his/her problems could be solved in an intervention (Öhman, Nygård & Kottorp, 2011). Moreover, it has been proposed that maintaining everyday occupations can support the structure of everyday life for persons with dementia (Öhman & Nygård, 2005). Some of the most important everyday occupations for persons with dementia could be those including ET such as a computer or a sewing machine, and these occupations therefore require the ability to manage ET (Nygård, 2008). This emphasizes the importance of the task for healthcare professionals of keeping updated in the changes that take place through the introduction of more and more technology, and the requirements of management skills that follow in supporting everyday activities for persons with dementia (Öhman, 2007).

Another way to compare observed and perceived ability to manage ET among older adults with and without known cognitive impairment is to compare the group level of person ability to manage ET assessed with the META to the group level of perceived

person ability to manage ET from the ETUQ (Nygård et al., 2011; Rosenberg et al., 2009b). In the META the level of person ability to manage ET is based upon observations, while in the ETUQ information on perceived ability is based upon an interview (Nygård et al., 2011; Rosenberg et al., 2009b). A visual comparison of the group-wise distributions of observed and perceived ability measures in the findings of the studies demonstrates similar patterns among the three groups. However, the group with dementia seems to perceive their ability to manage ET assessed with the ETUQ (Nygård et al., 2011; Rosenberg et al., 2009b) as slightly higher, compared to the other groups, than level of ability observed with the META. To clarify this, further research is needed.

The information gained from the META and ETUQ assessments shows both similarities and differences and could be used to complement each other in clinical practice. Using both observation-based and self-reported evaluations as part of a clinical evaluation process before planning and implementing interventions has been suggested (Fisher, 2009). The ETUQ could give valuable information to guide healthcare professionals about which ETs are perceived relevant and difficult, and therefore important to assess with the META. To be able to manage certain ETs can be important for the person in order to maintain self-image (Rosenberg, 2009). Moreover, the ETUQ may generate reliable measures to follow older adults with and without cognitive impairment over time to evaluate changes in perceived difficulty in ET use (Nygård et al., 2011). The ETUQ gives detailed information about the perceived relevance of ETs as well as in which ETs a person has perceived difficulties, but ETUQ does not provide information about the actual ability to manage the ET. However, the self-reported evaluations from the ETUQ or the META provide healthcare professionals with knowledge about how the client perceives his/her ability, which is important information when planning for interventions.

## Methodological considerations

In this thesis, several methodological approaches have been used to enlighten different aspects related to the management of ET among older adults with mild AD, MCI, and OA. Of course, each method has its shortcomings and in this chapter the main methodological limitations in the thesis will be discussed and critically reflected upon.

### *Sampling of participants, Studies I-III*

The sample consisted of 116 (Studies I and II) and 110 (Study III) individuals in three groups; they included older adults with mild AD, with MCI, and with OA. In the sampling, a match was striven for in the groups regarding age, gender, and years of education, as these aspects were believed to influence the ability to manage ET (Czaja et al., 2006). A power calculation was performed to predict the sample size of each group, to allow investigation of whether the META had the ability to separate the three groups from each other regarding ability in ET management (Study II). Our hypotheses were later confirmed in post-hoc power calculations using the actual sample sizes and person ability means for each group. Calculations using ANOVA with Bonferroni post hoc test and Pearson  $\chi^2$  test revealed no differences between the groups regarding gender, age, and years of education. Nevertheless, there are other aspects that were not accounted for, such as functional impairments and general health, which might influence ability to manage ET. Potential participants with visual and/or hearing impairment(s) that could not be compensated for with aid(s) were excluded from the studies. There are other age-related declines like decreased mobility or pain (Socialstyrelsen, 2009), though, which could have negatively influenced ability to perform everyday activities including ET management, that were not accounted for. Moreover, the participants' interest in and experience of ET was not considered in the analyses of the META assessments. As prior experience of an ET might affect future use in a positive direction (Langdon, Lewis & Clarkson, 2007), this may have been important to have gained information about.

There is of course a risk that the participants in Studies I-III are not representative of a larger population of older adults with and without cognitive impairment, and that may be a threat to the external validity (Kazdin, 2010). Potential participants with mild AD and MCI were not randomized from a total population, but were identified by strict inclusion- and exclusion criteria by professionals at clinical investigation units in collaboration with members of the research team. Nevertheless, some individuals in the MCI group may also have converted to dementia or have reversed to normal cognition and functioning since their last examinations at the memory clinic (Fischer et al., 2007). Also, the group of OAs was recruited from retirement organizations and similar networks. They were included on their own identification as OA, and some individuals can therefore incorrectly have been classified as being without cognitive impairment. These individuals may have regarded their potential

cognitive problems as a part of normal aging and therefore had not asked for an investigation; this is a common situation (Palmer, Fratiglioni & Winblad, 2003). The only assessment of cognitive function for the OA group was the MMSE (Folstein et al., 1975), which might be able to track changes in cognitive ability but is not recommended as a diagnostic tool (Mitchell, 2009). Thus to have been completely able to decide if the individuals in the OA group were without cognitive impairment, a more thorough investigation would have been needed. As there are no precise diagnostic boundaries between the three groups, there might be individuals who have been incorrectly categorized even though our criteria were strictly based on clinical examinations by physicians for the mild AD and MCI groups.

Furthermore, information of the subtype of MCI for the participants in the MCI group was not available and as the ability to perform IADL seems to vary between the MCI subtypes (Tam et al., 2007) this might have influenced the findings. Additionally, as persons with MCI have been found in several studies to have difficulties in IADL (Jefferson et al., 2008; Kim et al., 2009; Nygård et al., 2011; Pernecky et al., 2006; Tam et al., 2007), the question about how to clinically separate persons with MCI from persons with mild dementia has been raised. One feature that distinguishes MCI from mild dementia is the prerequisite for “essentially intact” IADL ability (Teng et al., 2010). However, as persons with MCI now have been demonstrated to have difficulties in IADL, the difference between MCI and early dementia is more indefinite.

Another issue regarding the sampling in Studies I-III is that of the potential participants who declined participation. Of those 63 persons (mild AD, n=27; MCI, n=25; OA, n=11) who declined participation, the most common reason was not being interested, n= 34 (mild AD, n=18, MCI, n=10, OA, n=6). Their refusals might have been made for reasons that could have influenced the findings. For instance, they could have declined due to lack of interest in ET or because of not having problems in managing ET. In any case, this may have affected the findings in either direction. Despite these potential shortcomings of the sampling, which could influence the generalizability of the studies, the findings about ability to manage ET in the three groups are in congruence with earlier studies (Nygård et al., 2011; Rosenberg et al., 2009a; Rosenberg et al., 2009b). This supports the generalizability of the findings in Studies I-III.

### *Sampling of participants, Study IV*

In Study IV, the findings are based on the views of the eleven participating healthcare professionals and should hence be interpreted with caution. However, as the aim of this pilot study was to investigate the applicability of a model for translating knowledge into healthcare practice, the findings could be seen as a benchmark for further studies. Also, the sampling strived to get a variation of participants regarding profession, type of professional area/setting, and working context in order to get rich data. Nevertheless, there are of course professions, settings, and context that are not represented among the participants. The 11 participants represent their own individual views rather than the views of a particular group or setting. Study IV was, however, based upon a qualitative approach, and in such studies the aim is not to make generalizations but to explore and learn more about a phenomenon and about the participants' views and actions (Charmaz, 2006). Including other groups of participants could, on the other hand, have further improved the understanding of the issues studied.

### *Data collection procedures, Studies I-III*

Studies I-III are based on assessments with the META. The META was developed to assess the participants' management of their own ETs that are chosen as relevant and currently used by them. The assessments were performed in one session. However, taking the findings from Study III into account, where variation in intrapersonal variation was found to be an aspect influencing ability to manage ET, it is apparent that a more longitudinal design would have been suitable to also capture management of ET and its potential variation over time (MacDonald, Li & Bäckman, 2009). A longitudinal design would also have been needed to capture continuous change in the interplay between the environment and the person (Scheidt & Norris-Baker, 2003). To assess and compare ability to manage ET, one could argue that all participants should be assessed on the same ETs. Using a Rasch measurement model (Bond & Fox, 2007) to evaluate the META made it possible, though, to allow the participants to be assessed in the management of different tasks (different ETs) of their own choosing. The methodological choice to assess the participants' management of their own self-chosen ETs was based on assumptions that the management of a relevant and well-known ET would have an influence on ability (Kielhofner, 2008). It would also give the most ecologically valid information about the participants' ability to manage ET. Additionally, to get as much knowledge as possible about their ability to manage ET, all assessments were administered in their homes or nearby (Bottari, Dassa, Rainville &

Dutil, 2010; Kielhofner, 2008). The decision was also made based on the proposition that when assessing a person's ability to perform everyday activities, it is important to consider the relevance of the actual activity for the person (Fisher, A.G., 1992a, Fisher & Jones, 2010, Kielhofner, 2008).

As described before, the assessments of ability to manage ET using the META in Studies I-III were made by observing the participants' management of their own ET. It was important that these ETs were sufficiently challenging to the person. Persons managing all assessed performance skill items for all ETs without any difficulties at all could not get an estimated person ability measure in the FACETS analyses. This is because a person with no difficulties is reported as "maximum". The nine persons in the sample that were rated "maximums" (mild AD, n=1; MCI, n=4; OA, n=4) in the analyses of the META were removed from further analyses. The "maximums" might be explained by the fact that these persons may not have perceived more challenging ETs to be relevant for them even if they had access to them (Rosenberg et al., 2009b; Selwyn et al., 2003; Tacken et al., 2005). Another reason for the "maximums" might be administrative error in the sense that the raters did not consider sufficiently challenging ETs to assess, i.e. person ability might not always have been well-targeted to technology and skill item challenge. Even though the persons themselves choose the ETs to assess, the raters have a responsibility to target ETs that are sufficiently challenging for each person. However, the META was specifically developed for clinical use among persons with mild AD and MCI, and participants in these groups were shown to be better targeted to performance skill items and ET challenge than the OA group. Still, in future studies with the META, raters need to be even more aware of the importance of encouraging clients to choose more challenging ETs to be assessed, especially if the clients seem to have a high ability to manage ET.

The rater's presence during the observations of the participant's management of ET in their homes might also have influenced the participant's ability. On the one hand, the rater might have caused stress in the participant and thereby influenced his/her ability negatively. On the other hand, the presence of the rater might have given the participant a wish to show his/her best performance, which would have influenced the ability positively. For the META items assessing intrapersonal capacities and environmental characteristics, the observation together with the rater's overall judgment of their impact on the person's

ability to manage each ET provided the base for the given score. For these items the rater's presence may have been particularly influential. Specifically, the assessments of the items assessing environmental characteristics could have been influenced by the presence of the rater, as the rater could be described as part of the environment in the assessments (Kielhofner, 2008).

A potential shortcoming of the META could be the assessment of the intrapersonal capacities items and the environmental characteristics items. The person and the environment could be seen as transacting and therefore difficult to separate in the assessments (Dickie et al., 2006; Law et al., 1996; Scheidt & Norris-Baker, 2003). However, in an attempt to capture both personal and environmental aspects of the ability to manage technology by using the META, they had to be separated (Law et al., 1996; Scheidt & Norris-Baker, 2003). As the ten META performance skill items measure the quality of the interaction between a person and an ET in the context of an everyday activity, the generated measures from the META could be viewed as measures of this unity. The intrapersonal capacities items and environmental characteristics items then add information to these measures. Importantly, in the META manual, there are detailed instructions about what should be assessed for each of the items (Nygård, 2006), which was expected to have increased the validity of the assessments.

In the data collection all raters were aware of each participant's group status, and that may have biased their assessments. On the other hand, raters did not know beforehand which performance skill items in the META or which ETs would show as more or less challenging in the Rasch rating scale analysis and this could minimize the risk for rater bias in the scores. As the raters' severity was not linked by assessing the same participants, they were assumed to be equally strict and therefore estimations of individual rater severity were not possible to generate from the analyses in Study I. The fact that the number of assessed persons ranged from 1 to 34 between the raters might also have influenced the findings, perhaps due to their different experiences in performing assessments with the META. However, none of the raters demonstrated unacceptable goodness-of-fit to the Rasch measurement model. In future studies this could be dealt with by letting all participants assess the same persons during the preparatory META training course.

### *Data collection procedure, Study IV*

The data collection in Study IV started with a one-day course, and then focus group interviews were held the following day. During the analysis it became apparent that it would have been interesting to have initiated the data collection with focus group interviews before the course. To have been aware of the participants' experiences and thoughts about technology use among older adults with dementia before the course would have been interesting when exploring the process of translating the knowledge and tools into practice. The process of translating knowledge into practice takes time (Baumbusch et al., 2008), and several of the healthcare professionals in Study IV suggested that a longer period of time to try out the knowledge and tools in clinical practice would have been beneficial. The relatively short time from the one-day course to the last telephone interviews (mean, four months) were perceived by them as too short. Insufficiency of time has earlier been shown as a barrier to implementation for research findings (Hutchinson & Johnston, 2004). In that case, a longer period of clinical tryout might have required more telephone calls to the participants, as several of them perceived the telephone calls to be good reminders to keep using the knowledge and tools.

It has been proposed earlier that focus group interviews may involve an aspect of learning (Dahlin-Ivanoff & Hultberg, 2006) and being helpful in the process of knowledge translation (Jacobson et al., 2003). In Study IV, the focus group interviews seemed to have had a significant role in the healthcare professionals' translation of the knowledge into practice. It was generally seen as very positive by the participants to have had the opportunity to discuss and reflect on the content in the one-day course in the first focus groups and after the period of clinical tryouts in the second focus groups. In accordance with Dewey (1998) they did in this way make the knowledge their own. The participants also described the focus group interviews as opportunities to try out and discuss their own thoughts and ideas, to get others' feedback on their thoughts as well as to ask questions of each other and of the researchers and group leaders. The mix of professions was also expressed as positive for giving new insights and ideas. The focus group discussions might still have been facilitated and deepened by letting the participants meet in focus groups on more than one occasion (Vik, Lilja & Nygård, 2007).

### *Choice of the Rasch measurement model*

In Study I, a Rasch measurement model was chosen to evaluate the psychometric properties of the META, and in Studies II and III Rasch-based person ability measures were used in the statistical analyses. This choice was based upon a number of assumptions. First, the Rasch measurement model is recommended as an appropriate method to use for development and validation of assessment instruments based on ordinal raw score data such as the META (Bond & Fox, 2007; Conrad & Smith, 2003; Tesio, 2003). Rasch models are increasingly used in the rehabilitation field in development and validation of new and existing assessments like the AMPS (Fisher, 2010), the Functional Independence Measure (FIM) (Linacre, Heinemann, Wright, Granger & Hamilton, 1994), the P-Drive (Patomella et al., 2006), and the Manual Ability Classification System (MACS) (Krumlinde-Sundholm & Eliasson, 2003). Second, using a Rasch measurement model made it possible to convert the ordinal raw score data from the META assessments into interval units of measurement. These interval units can then be used to conduct validity and reliability analyses on person ability and performance skill items and ET's challenge (Bond & Fox, 2007). Third, with a Rasch measurement model rater goodness-of-fit can be evaluated and measures can also be adjusted for rater severity (Conrad & Smith, 2003). Finally, as earlier mentioned, the Rasch measurement model made it possible to assess the participants on their own, self-chosen, and relevant ETs instead of assessing all participants on the same ETs, i.e. the measures are considered to be test-free (Wright & Linacre, 1987).

### **Ethical considerations**

Studies I-III were approved by the Research Ethics Committee at Karolinska Institutet. The Research Ethics Committee at Karolinska Institutet had no objections to Study IV, but regarded it as quality improvement, thus not requiring an ethical approval.

As it is of importance in all research that participants are informed about the research in which they will be take part, all participants in Studies I-IV received written as well as oral information. The information included facts about the research project, information about the participant's rights to withdraw their participation at any time, issues of confidentiality, and practical matters about their potential participation in the

study. Due to cognitive impairment, persons with dementia and MCI may have difficulty comprehending such information; therefore for the participants in Studies I-III this information was again explained during the session for data collection if the participants seemed to have forgotten the purpose of the visit. In the assessment sessions for Studies I-III, all data collectors were observant of whether participants showed signs of discomfort or exhaustion, and in such situations they offered to continue the assessments in another occasion.

The data collections for Studies I-III took place in the participants' homes and nearby. Conducting research in peoples' homes involves particular ethical considerations. However, the seven persons who collected the data were all occupational therapists familiar with undertaking assessments in their clients' homes and they were all well aware of the fact that the visits and assessments might be experienced as intruding on the participants' integrity. In cases where the data collector registered need of any care or support in everyday life this was discussed with the participant, and the data collector was prepared to either help the person him-/herself to contact a relevant healthcare provider, or after permission from the participant, contact a significant other. This happened in a few cases.

Involving persons with dementia or MCI as research participants requires knowledge of their potential difficulties in protecting their integrity. The data collector therefore had the responsibility to protect the privacy of the participants by helping them to set appropriate limits. One way to do this was to focus on the concrete questions of their management of ET in the assessment session, avoiding irrelevant and sensitive questions. The data collectors also needed to be flexible in order to let the participant decide when and where the assessments should take place.

## CONCLUSIONS AND CLINICAL IMPLICATIONS

The findings of this thesis have important clinical implications and provide knowledge about the ability to manage ET in older adults with and without cognitive impairment to occupational therapists as well as healthcare professionals in general, who support the everyday life for older adults at home.

The findings from Studies I-III show that the META has a potential to be used both in research and in occupational therapy practice to assess ability to manage ET in older adults with and without known cognitive impairment. In Study I it was shown that the META provided information regarding the level of a person's ability to manage ET. Also, the META provided knowledge of the level of challenge for performance skills needed in the management of ET as well as of the level of challenge for the assessed ETs. The META demonstrated validity in terms of acceptable person response validity, ET goodness-of-fit, and rater goodness-of-fit. The META was also found to be able to significantly separate persons on the group level with different levels of ability to manage ET. However, as the META did not fully meet the set criteria for internal scale validity in this sample, additional studies of the META are needed. After revision and further evaluation, the META could support clinicians with information about resources and limitations in their clients' management of ET. Such information can be important when planning and performing interventions. The META could potentially also be used as an outcome measure to evaluate the potential effects of such interventions supporting the ability to manage ET. Information gained from the hierarchy of performance skills items in the META might be used in the design and adaptation of technological services and artefacts.

In Study II it was demonstrated that the ability to manage ET, assessed with the META, significantly differed between three groups of older adults. Persons with mild AD had the lowest ability to manage ET, followed by the persons with MCI, and the OA. The ability to manage ET accordingly seems to be affected already in early cognitive decline, i.e. MCI. As ability to manage ET is important in the performance of everyday activities as well as for participation in society, it should be considered when assessing ability to perform everyday activities for people with mild AD or MCI. To aid clinicians in supporting ET management, the checklist (used as a tool in the model in Study IV) and the META hierarchy of performance skills items could be utilized.

The findings in Study III further revealed that, in addition to diagnosis, a person's ability to manage ET was significantly influenced by the variation in intra-personal capacities, such as capacity to manage stress and capacity to pay attention and focus, along with environmental characteristics. This finding suggests that these aspects are important to consider in assessments and support of ET management. In future evaluations of the ability to manage ET in older adults, different situations and conditions need to be taken into consideration in the assessments. It might be important for clinicians to make repeated assessments as well as assessments over time or in specific environments to receive more accurate information for planning interventions. In addition, in interventions to support ET use, clinicians could facilitate their clients' management of ET by considering and adapting their social and physical environment.

Finally, in Study IV it was shown that the model that intended to advise and aid healthcare professionals in supporting management of technology among older adults with dementia (including a one-day course, provision of clinical tools, and interviews during and after a period of clinical tryouts) seemed applicable. The healthcare professionals described that the knowledge and tools had given them an eye-opening experience concerning ET, including an increased focus on ET, and they had developed new ideas about how the management of ET could be assessed and supported in the everyday lives of persons with dementia. The knowledge and tools in Study IV provided the healthcare professionals with a new way of thinking regarding technology and persons with dementia. The knowledge and tools were creatively used by them as facilitators to support management of technology for their clients. Based on these findings, it would be important to provide healthcare professionals with knowledge of the ability to manage ET for persons with dementia, and also how this ability could be assessed and supported. These findings also imply that the model could be used as a way to translate knowledge of other issues produced in research into utilization in clinical practice.

## FUTURE RESEARCH

Research on the management of technology in everyday life for older adults with and without cognitive impairment is an important area which needs to be further explored. This thesis has generated new issues that would be interesting to explore in future research. The knowledge gained by the research also needs to be translated into healthcare practice. Continued research is needed to further explore how research knowledge could be implemented in practice.

In this thesis, persons with MCI were found to have significantly lower ability to manage ET than OA and significantly higher ability to manage ET than persons with mild AD. The ability to manage ET seems to be sensitive to changes in cognitive decline. However, as there were overlaps in ability among the groups, the differences only appeared at group level. In the future, it would be interesting to replicate the study to investigate whether META could also detect differences between individuals. Such differences would be important in investigation of both dementia and MCI. In addition, evaluating and comparing the ability to manage ET between the four sub-types of MCI would be interesting to generate new knowledge of the consequences of MCI in everyday life activities.

Revision and further evaluation of the performance skill items in the META are needed. To further investigate the META's ability to separate groups, it would also be interesting to add more items and investigate if that would make the META more sensitive for individuals with higher ability to manage ET. Moreover, an investigation of the concurrent validity of the META is needed. One way to do this could be to compare the person ability measures from the META and the measures of perceived difficulty in ET use from the ETUQ, i.e. to compare the persons' observed and perceived ability to manage ET. Additionally, an analysis of differential item functioning (DIF) could provide relevant information about how the items in the META function in the three subgroups of people with MCI or AD and OA. Finally, investigation of the relationship between the ability to manage ET and the ability to perform IADL, social ability, and computer-related skills would be important to receive more knowledge in this field, and particularly about the construct of managing ET.

It would be clinically relevant and interesting to perform studies where the applicability of information gained through the hierarchies of ET and META performance skill items challenge is tried out in interventions to support the ability to manage ET. It would also be interesting to investigate how the hierarchy of META performance skill items could be used in design of ET.

In this thesis it was found that variation in intrapersonal capacities influenced the older adults' abilities to manage ET. However, the assessments with the META were only conducted on one occasion, and then only the variability between different ETs was assessed. Longitudinal studies to capture the potential variation within ETs, and also to assess how the variation in intrapersonal capacities influences the ability to manage ET over time, would be interesting to investigate further.

Finally, the model used in the pilot study IV would be interesting to use in a larger intervention study over time to gain additional knowledge about how the model could be implemented in clinical practice. In such a study, new research knowledge such as the findings from Study III could be added, as well as findings from other recent studies in the field.

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