ELDERLY PEOPLE'S ATTITUDE AND ACCEPTANCE TOWARDS SOCIALLY ASSISTIVE ROBOT

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Abstract

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Title
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As the world aging population is increasing, the problem of nurse shortage has also become prominent worldwide. While the lack of enough health care provider causes many health-related problems: aggravate occupational stress and burnout, which are also put patients at risk. Technology development could bring new solutions to this problem, for instance, the robots have a potential ability to play a role in the health care area. Robots have been accepted worldwide as assistants in daily life, conversely, the public opinion is against that the robots could be used as assistants in children and elderly care. It is meaningful to make it clear why people think like this. The aim of this thesis is to find out factors that influence the attitude of the elderly towards human assistive robot.

The purpose of this thesis's result can lead to a better understanding of the elderly therefore helps the designer to improve the quality of application according to real needs/feedback. At the same time facilitates health care providers' understanding the meaning of using robot, in the future health care providers could give their patients or customers enough instructions and explanations, assisting elderly understand robot and new technology in a better way.

Descriptive literature review was conducted as research method and content analysis was used to analyze collected data. Elderly's attitude yielded into 3 categories, namely, changed to positive, changed to negative and keep neutral. Factors influenced the elderly's acceptance yielded into 2 categories: related to robot and related to elderly. Three sub-categories under "related to robot" were yielded into: appearance, robot function design, human-robot interact mode. Three sub-categories under "related to elderly" were yielded into: personal background, concerns, and misunderstanding, perceived robot mind. In conclusion, this literature review showed diverse, adequate pre-contact instruction and sufficient technique support, together with robot designed in a user-friendly way were the key points to succeed. In the future, government and the related departments still need to perfect laws to protect privacy and to solve financial concerns of end-user, meanwhile discover deeply how health care pro-

Keywords

elderly, attitude, acceptance, socially assistive robot

Tiivistelmä

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Julkaisun otsikko

Ikääntyneiden asenne sosiaalisesti avustaviin robotteihin ja niiden hyväksyntään vaikuttavat tekijät

Tutkinnon nimi

Sairaanhoitajan kandidaatti

Maailman väestön ikääntymisen myötä sairaanhoitajien kasvavasta työvoimatarpeesta on tullut näkyvä myös maailmanlaajuisesti. Vaikka riittävien terveydenhuollon tarjoajien puute aiheutti monia terveyteen liittyviä ongelmia: pahentaa työstressiä ja uupumista, asettaa myös potilaat vaaraan. Teknologian kehitys voisi tuoda uusia ratkaisuja tähän ongelmaan, esimerkiksi robotilla on potentiaalinen kyky työskentella terveydenhuollon alueella. Robotti hyväksyttiin maailmanlaajuisesti avuksi päivittäisessä elämässä. Sitä vastoin, yleisö kieltäytyy robotista terveydenhuollon tarjoajana lasten ja vanhusten hoidossa. On tarkoituksenmukaista selvittää, miksi ihmiset ajattelevat näin. Opinnäytetyön tavoitteena on selvittää tekijöitä, jotka vaikuttavat vanhusten asenteeseen humanoidisen avusttavaan robotteihin. Yhteenvetona voidaan todeta, että tämä kirjallisuuskatsaus osoitti monipuolisen, riittävän ohjauksen ja riittävän teknisen tuen yhdessä käyttäjäystävällisellä tavalla suunnitellun robotin kanssa. Jatkossa hallituksen ja siihen liittyvien osastojen on edelleen täydennettävä lakeja yksityisyyden suojelemiseksi ja loppukäyttäjien taloudellisten huolenaiheiden ratkaisemiseksi, samalla kun selvitetään, miten terveydenhuollon tarjoajien mielipiteet avustusrobotista.

Opinnäytetyön tarkoituksena voi johtaa vanhusten parempaan ymmärtämiseen, minkä vuoksi suunnittelijat voivat parantaa sovelluksen laatua todellisten tarpeiden / palautteen mukaan. Samanaikaisesti terveydenhuollon tarjoajat ymmärtävät robotin käytön merkityksen, ja tulevaisuudessa terveydenhuollon tarjoajat voisivat antaa potilailleen tai asiakkailleen tarpeeksi ohjeita ja selityksiä, auttaa vanhuksia ymmärtämään robottia ja uutta tekniikkaa paremmin.

Tutkimusmenetelmä tehtiin kuvaava kirjallisuuskatsaus ja kerätyn tiedon analysoimiseen käytettiin sisältöanalyysiä. Vanhusten asenne jaettiin kolmeen luokkaan, nimittäin muuttui positiiviseksi, muuttui negatiiviseksi ja pitää neutraalin. Vanhusten hyväksyntään vaikuttavat tekijät jaettiin kahteen luokkaan: liittyvät robottiin

Avainsanat

Vanhukset, Asenne, Omaksuminen, Sosiaalisesti avustava robotti

CONTENTS

1 INTRODUCTION

World aging rate has increased all over the world significantly. According to WHO statistic data (2018) reported, older adults over 60 years would double from 900,000 in 2015 to subsequent 25 years, reaching 22% of population proportion in 2050. By year 2050, there will be eighty percent elderly living in countries of the second and third world. With the problem of aging approaching, not only developed countries but also developing countries will experience a long-term challenge both in social welfare and healthcare system. (WHO 2018.)

Health care providers are a specific group of occupations at risk of burnout. Health care providers compared with other non-healthcare workers, had reported to undertake extremely higher level of stress from their working place. (Rees & Cooper 1992.) This could be one of the reasons why nursing shortage continuously exist. Nurses have repetitive workstyle, continuously in contact with ill patients and face directly death longer than physicians. 8 hours working duration per day is long and overload often occurs, when working hours prolonged to 12 hours, more and more nurses reported fatigue. One feeling expressed by nurses about burnout was that they made more mistakes and cannot concentrate on the work. Nurses were in fear of giving wrong medication to patients, at the same time for nurses to think about how to schedule patients into their shift is demanding. Those nurses worked in a small nursing home, facing more often the death of the elderly were under stress too. Same situation occurs to other related professionals in health care area, like physicians, mental health care workers, social workers and related health care providers were at high risk of burnout. (Felton 1998.) The syndrome of burnout presents as emotional exhaustion, depersonalization and made less personal accomplishment (Maslach & Jackson 1981). Aiken et al (2002) investigated the relationship between registered nurse and patient mortality in a cross-sectional survey, adjusted higher patient-to-nurse ratio could extremely increase patient mortality and nurses experienced lower work satisfaction and easier to burnout (Aiken, Clarke, Sloane, Sochalski & Silber 2002).

What's more, nurses and midwives are significant components of workforce in health care system. They are the largest group among health care providers. Till 2012, there were 190,000,000 nurses and midwives all over the world (WHO 2012, 3). Data in the year 2007-2016 reported by the World Health Statistics Report (2018) that every one thousand people had less than 3 nurses or midwives who can take care of them, more than 40,000,000 population was in need of quality-assured health care service and WHO approximated that world-wide there was still need for more than 43,000,000 health care workers (World health statistics 2018, 8).

As the technology is developing extremely fast it could bring some new solutions to world aging and nurse shortage. Robots with different intensions were designed and used in many industries worldwide, they had undertaken a lot of workforce for human beings in many areas. Nowadays, robots are widely used in service-providing, teaching, manufacturing industry to replace human beings in order to save human resources. Robot could take part in repetitive work, made less mistakes than humans, good at company with elderly like pet robot Paro, and providing emotional support even psychological rehabilitation to the elderly. (Wikipedia 2018.) So robot could be a remedy in terms of this issue, intend to relieve conflict between world aging and nurse shortage.

When robot is designed to improve quality of life, how do people feel about robots? Japanese roboticist Masahiro Mori in 1970 presented his famous “Uncanny Valley” hypothesis of human emotional change towards humanoid robot: when a humanoid robot looks exactly the same with either human or machine, then it was fully accepted by people, but as long as it looks a little bit not that “human”, the perceived emotion would dropped to the “valley” and people felt horrible about it (Mori, MacDorman & Kageki 2012). Especially for older people, they were generally reported that they couldn’t adapt to high-tech life and felt isolated when the whole society developed faster than they could understand. Aging in both physical and psychological, for example, chronic diseases like cognitive impairment, would lead elderly’s fear and distressed about new technology, end up with technology abandon or refuse. How their attitudes towards robots are important to make clear. (Holzinger, Searle & Nischelwitzer 2007.)

Thus, having explored attitude and what impact their attitude towards robots can influence robot use, the aim of this thesis is to find out factors that influence the attitude of elderly towards human assistive robot. The purpose of this thesis’s result can lead to a better understanding of elderly therefore helps designer to improve the quality of application according to real needs/feedback. At the same time facilitate health care providers understand the meaning of using robot, in the future health care providers could give their patients or customers enough instructions and explanations, assisting elderly understand robot and new technology in a better way.

2 AGING IN PLACE AND NURSE SHORTAGE

Nowadays, most people could live longer lives than ever before, with an average over sixty or even older. Through incredible medical and technology development, children, maternal and elderly mortality decreased and expectation of life span increased, population structure modification leading to a new problem: world aging. Prolonged life span could bring many benefits not only to self-development of human and also contribute to the society, for instance, artists or supervisors, these professions need time to grow to a mature one, proceed most relay on experience accumulation, people live longer could participate and contribute more than before. If the elderly stayed in good health conditions, they could work longer and be more conductive to society by participating and cooperating in many methods. Elderly also could make valuable efforts in their extra years if they are healthy and obtain enough support from the environment. On the contrast, older population could become a black hole for the society if they are in great need of help in both physical and psychological, give extra burden negatively. While what ended up crucially, was the fact that the older population had received the least medical service resources though they were the group who need most. (Global strategy and action plan on ageing and health 2017, 3.)

Aging in place was defined by Davey et al (2004) as “remaining living in the community, with some level of independence, rather than in residential care” (Davey, de Joux, Nana & Arcus 2004). Home, or community, a beautiful word with an inherent warmth, is the place where people live and familiar to. Everything is placed according to preferences of host at home, neighbors live around are mutually understand, acquainted living surroundings and facilities could be some extent of physical, psychological and religion support to everyday life. Unfortunately, once people get ill and they start in need of not only medical treatment but also therapeutic devices to continuously monitoring and giving medications, they have to leave from home to health care settings or nursing home, which against their willing of staying in the familiar and warm place where they used to. Especially elderly with chronic diseases combined with cognitive disorder, to stay at home seems to be the reasonable choice for them to feel psychological safe and warm, receiving home-based care including treatment and rehabilitation. (Wiles, Leibing, Guberman, Reeve & Allen 2012.)

The overwhelming majority of elderly age over 65, nighty percent of them would like to choose “aging in place” as long as possible though they have to pay considerable budget for visiting service. Eighty percent of the elderly voiced that they can even render up some of privacy without reluctance in order to continue living at home (Barrett et al. 2011, 1). In

Finland, the elderly preferred staying at home as long as they could despite some limitations might restrict their mobility (Hennala, Koistinen, Kyrki, Kämäräinen, Laitinen, Lanne, Lehtinen, Leminen, Melkas, Niemelä & Parviainen 2017, 12.)

With the growing need for elderly to live a better life, meanwhile, nurse and health care provider shortage all over the world continues had become a global problem. WHO (2017) divided health workforce based on their categories into three groups, 1) health professions, which indicated workers were well trained at least with a bachelor's degree or more; 2) health associated professions, which indicated they were trained and educated enough, but usually under bachelor's degree; 3) personal care workers in providing health care services, which indicated they were only assistant or personal care providers usually at customs' homes (WHO 2017, 6-7). According to data and statistics reported in WHO webpage, in Europe, taking the salary and social status into account, there were inadequate in supply and demand because less and less young people would like to choose nurse as their career, coupled with gradual retirement of old nurses made the situation even worse off (WHO 2018).

By the year 2030, there estimated health worker shortage in nurse and midwife all over the world grows up to 7,6 million, physicians 2,3 million, other cadres 4,6 million, in total 14,5 million workforce shortage (WHO 2017, 15).

Nurse and health care provider shortages also caused negative impacts on health care providers themselves. Fatigue and burnout contributed to chronic nurse shortage. Burnout resulted in many aspects: physical, mental and social consequence. Because nursing was more than a job, it combined art and skill together, making efforts on other's quality of life and impact long-lasting in their life processing. (Waddill-Goad 2016, 22-24.) The normal nursing style was busy, high frequency and repetitive. Trifles and so many other chores occupied most of nursing work at the same time brought extra stress to nurses too. The nature of taking care of others could contribute to nurses' occupational burnout also. Because sometimes the boundary of caring itself, for example, unclear caring time duration and unlimited compassion, would potentially give a possibility to occupational burnout. (Waddill-Goad 2016, 28-31.)

Lack of health worker continuously could involve more and more informal health workers into health care area in order to alleviate human resource shortage stress especially in long-term care service. Non-health care related workers worked as professionals do, but often their working conditions were far from satisfied, working hours were prolonged,

breaks between working hours and holidays were not clear, lack of protection in work-related sickness, these could bring negative impacts to them like burnout or old age impecunious. (WHO 2017, 153.)

Nurse and health care provider shortages caused many nursing care related problems to the patient. The largest private healthcare company all over the Nordic countries, involved in the scandal of mistreat patients in the year 2019. Police, Valvira and regional state Administrative Agency invested this case. (Munukka & Järvinen 2019.) Another private company had confronted with the same problems of mistreat elderly. What had been found in the following investigation showed that the main reason was the shortage of human resources. Many elderly had low IBM and malnutrition, they were facing raised risk of early death. Prescription medications were lack of prescription, for instance, opioid-containing medication and these medications were distributed to residents without doctor's documents. Feedback of private nursing home was low in recent years, lack of "trained nurse". In the contrast of heavy workload, in 2016 regional research while showed 6 of 8 on duty were casual laborer, every night shift nurse need to face ten residents. (Mäntymaa & Roslund 2019.)

Finland will face nursing shortage continuously. Finnish Prime Minister Antti Rinne had decided to raise to 7 nurses per 10 population in elderly care, as a result of which more than four thousand nurses were needed in Finnish Labor Market in the future (Yle 2019).

To find a solution between increasing needs of nurse and aging requirements, keep elderly's quality of life and maintain social functioning at the same time provide a safety living environment for older adults, socially assistive robot were able to contribute a huge potential in company, monitoring, risk preventing, increasing independence and emotional supporting dwelling elderly. An official survey showed socially assistive robots might lead a future market trend to trillion-dollar by year 2050 overcoming industrial robots enormously (Manyika et al. 2013, as cited in Damholdt 2015).

3 ROBOT CLASSIFICATION

3.1 What is a robot?

Robot, a fantastic character often appears in movies and science fiction, connected with future high-technology war, or an ice-cold hearted artificial worrier without any feelings. The first word “robot” coined in a Czech science fiction play called “Rossum's Universal Robots”, the writer of this science fiction, Karel Čapek, first put forward “robot” derived from a Czech word “robota” as a subtitle of this play in 1920. (Wikipedia 2018.)

Oxford dictionary (2018) gave the definition of robot as an artificial machine represent a human being and has ability to repeat particular human activities and functions without a manual operation (Oxford dictionary 2018). Roboticist Rodney gave definition to robot in Erico’s article “What is a robot”: robot is a spontaneous machine which has the ability to recognize surroundings, to decide by calculating, to react in real life with people emotionally and to change the world outside its body. (Rodney & Erico 2019).

As robotic technology develops, many robots with different intensions were designed and used in many industries worldwide. It is hard to identify and put them into certain categories but approximately can be divided into 15 different robots, they are 1) flying robot: both flying on earth or in space exploration; 2) consumer robot: pet dog-like robot and sweeping robot are good examples, they were designed to make fun or suitable to do light housework; 3) disaster response robot: used in disaster detecting and surviving; 4) drones: they were also named as unmanned aerial vehicles (UAV), used in military detecting or other areas, different in its size and functions; 5) teaching robot: used in education act as a teacher or enriching teaching method; 6) entertainment robot: used to cheer up audience and evoke feelings; 7) exoskeletons: to help disabled people mobility and carry heavy things ; 8) humanoid: had an human-like appearance; 9) industrial robot;10) medical robot; 11) military and security robot; 12) research robot; 13) self-driving cars 14) telepresence robot; 15) under-water robot. (Robots 2019.)

Nowadays, robots are widely used in service-providing, teaching, manufacturing industry to replace human beings in dangerous places or heavy operations, for example, in space exploration, in the steel-making industry where the operating environment has a high temperature. Robot appliance surely saved human resources meanwhile increase productivity, had liberated human from heavy and repeat physical labor. (Wikipedia 2019.) Well-known Chinese online retailer JD Company has a large warehouse where using robots to pick, pack and deliver packages. Instead of hiring 500 people to do those work, now only

one person is needed just to supervise general robot system operations (BBC 2016). Finland has used rubbish robots designed by ZenRobitcs Company, it can detect and identify different sorts of rubbish and separate them from mixed rubbish to special groups (Yirka 2011). In year 2018, the first robot bus was put in use for 6 days trial operation in Helsinki Kivikko area. The next year robot bus joined to bus routine from 21.5.2019 worked from 9 am to 3 pm every weekday in Helsinki Kalasatama area every 20 minutes till November, 8 person maximum including one supervisor sit on the bus with passengers. (Reitti 2019.)

3.2 Robot in medical area

Even in medical industry robots can even complete surgery for patients. In Helsinki University Hospital, the first heart operation assisted by a robot was carried out in the spring of 2011. In the further surgery many advantages has been proved, like smaller surgery wound, remarkable shortened post-operation recovery period, and the robot operate with non-shaking artificial hands and has a tenfold more precise view compared with human eyes. (HUS 2019.)

Micro-robots are tiny individual independent robot which can move in human body and do specific targeted therapy, remove material from veins or structural control. Concentric tube robots also named as active cannulas, unlike traditional examine equipment, they are small in size and easy to turn like a needle, it tracks down possible approaches to inaccessible deep body cavity. Exoskeletons, also known as wearable robots, can help amputated patients, movement disorder patients after stroke and muscle weakness to obtain normal motor ability thus maintain the capacity of daily life. Patient simulator robot is also a method for clinicians or medical student to train their clinical skills. Artificial but emulated robot simulate human reaction, sense and respond to student’s action. (Riek, 2017.)

As a health care service provider, Robot Pepper was the only public health care robot work in the capital city of Finland, Helsinki, in the year 2018. Ministry of Social Affairs and Health held a project for facilitating the use of robots, AI, and automation in order to save costs and relieve pressure from lacking human resources in health care area. It had been claimed that in the year 2016, 1/5 of nurses and 4/5 of nurse’s work could be replaced by robots. While in contrast, to the year 2018 the only robot at work was Pepper, to please to customers in health care center for child and elderly. No one was replaced by Pepper, instead of that, the price of the robot itself had cost a lot and monthly maintenance brought 1000 euro burden to health care settings. Advantages were also founded despite many disadvantages, that the robot could bear heavy workload and able to work longer than humans. (Yle 2018.)

3.3 Socially assistive robot

The EU had played an important role in robotic development, sharing more than 1/3 global industrial robot market and around sixty percent of serving professional technical support. Finland, was the fourth leading country in Europe, treading on the heels of Germany, Italy and Sweden, not only the base of installation but also one of the largest customers in the automobile. Europe had many research and development centers and universities study on robotics. European Commission's goal till 2020 had been set to obtain about 15 billion robot market and 1/5 of total 2.4 billion home-relating robot market. (Bogue 2014, 487-489.)

When robotics substantially develops nowadays, a potential role for robot to act as a support method in gerontology has emerged prominently (Pollack 2005). The assistive robot is a kind of compensatory device for elderly or disabled people which will give great help to their daily life through automatic monitoring and take corresponding action according to information gathered (Dave Jaffe, 2014).

Broekens et al (2009) described in a review article explained that assistive robots for the elderly can be divided into two categories: rehabilitation robots and assistive social robots. Then assistive social robots still could be divided into service type and companion type according to its different functions. The first mentioned of two, namely service type mainly work to give support in routine, for example, feeding food, give a hand when people showering and help to put on clothes, guide when elderly cannot find way to target destination and help them move from one place to another, monitor vital signs and evaluate risk constantly. Companion type robots put more energy on mental health of people, with more animal-like appearance focus on improving psychological well-being of the elderly. (Broekens, Heerink & Rosendal 2009.) Although not all the robots could be simply divided into certain category and there were also some kinds of robots can do both or even more, the author would not go into details but what focused in this thesis was socially assistive robot which have a human appearance, namely humanoid assistive robot. Rehabilitation robots were not included in this thesis. Assistive robot which singly provided physical support were excluded in this thesis either because the social function of robot was seen as an external reflected function rather than the original intention of the design. Tele-operated robot was excluded also, since tele-operated robot was lack of ability to act or control itself and make decisions alone. In a sort of sense, tele-operated robot was like a platform to build a social relationship between user and operator, however, the robot itself did not have typical social feature. (Vandemeulebroucke, de Casterlé & Gastmans 2018.)

4 ATTITUDE TOWARDS ROBOT

4.1 Attitude of public and health care providers

Robotics has developed dramatically, meanwhile, will it really accepted by people or not is essential to make it clear. Search result of public attitude towards robot in pan-European showed almost seventy percent of participants thought that in dangerous and heavy labor situations, for instance, auto industry or explore the space, robot was a good choice to replace human beings, but robotics should not be applied in children, elderly and disabled care, only 4% thought that robot should be used in children, elderly and disabled care. 57% of the public expressed feeling uncomfortable to get surgery by medical robots. Public also concerned about robot would replace real-human job opportunities, from lowest North European 51% to almost 90% in South European, Finland located in the second lowest in the list, more than half people worried about robot would take human being's working opportunities. Research also showed Finland had the highest rate of using a robot at work place, which might contribute to a lower percentage of worrying robots replace human work opportunity. (Bogue 2014, 490-491.) Because the more experience people had to contact with a robot, the higher acceptance rate they had to receive a robot (Hennala et al. 2017, 3).

When the innovated robot technology was recommended to healthcare system, all the potential users' attitude and acceptance should be understood thoroughly, elderly and healthcare providers included. Because health care providers' understanding towards robot was essential to spread and apply robot assistance in health care settings. (Mitzner, Kemp, Rogers & Tiberio 2013.)

Healthcare providers played an important role in robotics popularization and application. In order to achieve success in serving new technology, the value of innovation itself and users, those included in this network were two indispensable factors. The holistic perspective helped to understand deeply how people impact each other in the network and to observe what impact robot can bring into the network. As elderly often took robot as a hard barrier need to conquer or a threat to their life, health care provider's attitude to robot was essential for elderly to receive robot technology. If a robot was introduced with more positive feelings and focused on how much use it could bring to elderly care, older people would easier to accept robots as a part of health care basement. Recognizing the elderly's concerns and giving solutions to avoid possible co-destruction, utilizing network to impact other people by emphasizing the importance of co-creation, explaining how robots fulfill

their willing and enhancing privacy protection were the factors that could influent robot spread. (Čai, Odekerken-Schröder & Mahr 2018.)

In Mitzner et al research (2018) revealed that health care providers expressed willingness to use a robot as a “third hand” in physical tasks or manual labor such as housework, lifting patient from bed to chair. While in intravenous infusion, health care providers tended to trust humans than the robot because they worried about robot is not reliable as showed in interaction capability and response manner. In their point of view, the robot was accepted as suitable for easy light work but not reliable for complex medical tasks so their patients could refuse to contact with a robot too. Health care providers also holding negative opinions towards the robot as they were afraid this kind of assistive robot will take their job opportunities in the future. (Mitzner, Tiberio, Kemp & Rogers 2018.)

4.2 Attitude of elderly

BBC reported in the year 2011, Japanese elderly were discovered as not accept robots to take care of them because they preferred human contact rather than humanoid robot. Financial problem was one of the reasons, robot cost a lot meanwhile robot technology still remain immature, has not developed equivalent to the price value. Lack of interest client, failing to meet custom needs plus high price, Japanese humanoid robot company struggled in this difficult situation. (Michael 2011, 2-3.)

Frennert et al (2013) discovered Swedish elderly’s expectation about the robot in mixed-method, questionnaire result revealed 77% of participants don’t want to do things together with the robot and 74% tend to disagree robot to keep company. Interview of imaging how domestic robot would be presented, result discovered that elderly were afraid of breaking the robot, strongly hoped they could get detailed instruction when testing the robot or someone could teach them if something wrong appears. Most of them would like to choose to record each step by writing them down in paper due to reading long instruction is too demanding for them. They also expressed about the feeling of being frustrated by new technology and strongly wish they could get enough help and information, like health care providers providing regular visits to solve possible problems after the robot has been applied. Research also discovered about how informal caregivers’ opinions, all of them believed elderly were not able to learn how to use a robot, most of them even think robot could scare the elderly. (Frennert, Eftring & Östlund 2013.)

One the other hand, pet-like robot Paro spread rapidly in Japanese health care settings and personal homes, accepted by many elderly as a good choice for company, had reached commercial succeed not only in Japan but all over the world in recent years. Over

one thousand Paro had been sold and put in use in Japanese hospitals, elderly care homes and personal own homes. Paro was even listed in Guinness World Record 2002 as “World's Most Therapeutic Robot”. Compare to other humanoid robot, Paro had won landslide victory not only because it has more skillful robot functions but also it showed emotional responses to human beings. (Michael 2011, 4.)

Also in a Japanese survey investigated how pet robot Paro impact elderly and nurses in an elderly care center, results confirmed Paro could increase human contact between elderly and cheered them up in mood, consequently elderly became more energetic in daily activities. What’s more, nurse stuffs benefits from Paro too when Paro introduced to elderly, the need for nurses’ attention to elderly decreased, thereby nurses’ workload alleviated, burnout score changed from high to a low score and kept stable until the end of trial. (Wada, Shibata, Saito & Tanie 2004.)

Some research results (Phillips & Zhao 1993, 36; Scherer & Galvin 1996, 1-26) claimed that the first year of use has the highest rate of technology abandonment, ranging from eight percent to seventy five percent on the basis of device, during which the first three months is the most possible time for people to abandon. This finding was not aiming at elderly, just described how general attitude toward technology. To make a well-designed device work efficiently, the designer must fully understand what the user’s real needs are and what kind of environment users are living in. In addition, limited test time and shoestring budget were essential factors, if lack of any of them could cause a problem that the devices were tested on users who are not target people instead of testing those who really in need of devices. Poor-designed devices along with inadequate feedback collection could extremely restrict the development of technology. (Boyd-Graber, Nikolova, Moffatt, Kin, Lee, Mackey, Tremaine & Klawe 2009.) Technology abandonment caused a huge waste of resources and energy, forming the “lose-lose” situation. Compare to younger individuals, older people have those features particularly: processing required time prolonged, lacking inhibitory control, declined sensation and working memory ability, declined efficiency of perceptual processing (Wilmoth & Ferraro 2007, 98.) When the author was completing clinical training with the elderly in Finland, experienced such many times older adults complained about they do not like new things at all and they had difficulties in learning new technology, which described as “extremely hard” and “beyond their apprehension”.

Are the elderly too old to use new technology? When people getting older, physical and mental decline could influence processing speed and memory time prolonged. While Feingold Polak and their team (2018) implemented research focus on how the differences

between younger group and older group towards robot Pepper, 30 people of each group, the result after real contact confirmed that two groups had no significant distinction, though younger group required shorter robot response time than older group in robot functioning and screen control. Both groups expressed positive impression about the robot, contacting with the robot was funny and they felt comfortable. The older group interacted with the robot in a more human-like way, for example, they pet robot hand more often than the younger group. Because in real social contact, body contact was a main way to increase interpersonal attachment and enhance social interaction. Contact with robot acted as a compensation to their daily loneliness on account of social isolation. (Feingold Polak, Elishay, Shachar, Stein, Edan & Levy Tzedek 2018.)

Hence, realized how sever world aging and nurse shortage condition is, then robot had the potential ability in assistive and company, but there seemed to be barriers between them, the author would like to looking for answers about how elderly's attitude toward socially assistive robot and to see further what factors can impact on it.

5 AIM AND PURPOSE, THESIS QUESTIONS

The aim of this thesis is to find out factors that influence the attitude of elderly towards human assistive robot.

The purpose of this thesis's result can lead to a better understanding of elderly therefore helps designer to improve the quality of application according to real needs/feedback. At the same time facilitate health care providers understand the meaning of using robot, in the future health care providers could give their patients or customers enough instructions and explanations, assisting elderly understand robot and new technology in a better way.

Thesis questions:

1. What are elderly people's attitudes towards humanoid assistive robot?

2. What factors influence elderly people's acceptance towards humanoid assistive robot?

6 METHODOLOGY

6.1 Method and process

There are thousands of literature all over the world, the literature review is an essential skill for health care student to get familiar with, no matter it is a pre-research before a big project or just a small work for our own because by doing literature review people could find a summary to one certain topic. Literature review means by using a particular searching method to collect all state of art articles related to research questions, analyze and evaluate the gathered information, discuss the shortage and advantage of every article, during which might get new understanding among complicated situation and finally demonstrate the results in a comprehensive way. (Aveyard 2014, 2-4.)

There are many types of literature review, as a degree student, the author choose to use descriptive literature review to conduct this thesis. A descriptive literature review is to give a description of the main point of each article that the author has found related to one selected topic. Then appraising and combing those findings together, consequently present in the final review. (Coughlan, Cronin & Ryan 2013, 3-5.) In order to complete this thesis, the author searched and obtained enough information related to the topic, obtained a better understanding of the topic, knew in deep what efforts had been done by other researchers and what were their main findings in a critical way. Therefore the author received not only a panorama of the topic but also received insights from past studies, informed further study direction, leading to a better academic development and ability to give a proposal to the future study. (Blaxter 2010, 120-121.)

6.2 Search strategy

The databases searched in this thesis were Pubmed, CINAHL (EBSCO) and Applied Science & Technology Source (EBSCO) on account of robotics in this thesis both in relation to applied science & technology and health care. Keywords combined with Boolean operators were used in search strategy: (older adults or elderly or seniors or geriatrics or older people) AND (attitudes or perceptions or opinions or thoughts or feelings or beliefs or behaviors or acceptance) AND (Robot*). Asterisk * used as the truncation symbol to allow diverse word endings included in search results. “Robot*” was originally set as “assistive robot*” due to limited search results which showed only 6, the author decided to change keyword to “robot*”. After comparing the differences between keyword “behaviour” with American English “behavior”, the author decided to use “behavior” as one of the keywords due to more relevant literature had been found.

The first database used in literature retrieval was PubMed available through Masto Finna. Same keywords and Boolean operators applied, limited to text word, English, full text available, from published year 2010-2018. Search resulted in 61 articles, of which 17 were selected by abstract for eligibility in the final literature review. Final selected 5 of them according to the study method and type of robot.

In search results, there was a thesis using the systematic search method (Vandemeulebroucke et al 2018). The author didn't choose this systematic review as a direct reference, because after reading it the author found that it had a close publish time, in the year 2017, which means it could have overlapped with this thesis. What's more, this systematic review included many pieces of researches that described non-real contact with the robot, for example, participants just sit there and watching demonstration or videos. Then this systematic review was used as a snow-balling method, two articles were selected in the final review.

The second database was CINAHL with full text (EBSCO) available through also LAMK electrical library link. Same keywords and Boolean operators applied limited to English, full text, from the published year 2010-2018 and peer reviewed. The author didn't select a field due to a limited amount search result. 16 hits in total, duplicated excluded and 1 of which was selected in final literature review but coincided with the previous search results.

The third database was Applied Science & Technology Source (EBSCO). In consideration of thesis was related to robotics, the author decided to use this database to search for more information closed to technique as a compensatory retrieval strategy. Same keywords and Boolean operators applied, limited to English, full text, from the year 2010-2018 and peer reviewed. Altogether 26 hits showed up, duplicated articles eradicated that of the previous two databases. Ultimately 0 articles selected in the final literature review.

Inclusion and exclusion criteria were listed as below (in Table 1), data search process results were listed step by step (in Table 2).

Table 1. Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
Published date from the year 2008-2018	Published date before year 2008
Article is published in English	Article is published in languages other than English
Article is full text available and peer reviewed	Article is not peer reviewed or not available in full text

Target people are elderly	Target people are other than elderly or elderly is only one part of target groups
Robot is not used as a main therapeutic strategy	Robot is used for main therapeutic strategies, such as surgery or rehabilitation
Assistive robot is a humanoid robot	Assistive robot is pat-like robot
Participants have real contact with the robot	Participants don't have real contact with the robot, such as watching a video of a robot or watching researcher demonstrate a robot.

Table. 2 Data search process

Research Database	Initial number of article searched according to keywords and inclusion criteria	The number of article selected according to abstract	Final selected in final literature review
PubMed	61	17	5
Snowballing one systematic literature review from PubMed		9	2
CINAHL with full text(EBSCO)	16	7	1(coincided)
Applied Science & Technology Source (EBSCO)	26	9	0

6.3 Data analysis

The main data analysis method in this thesis was content analysis. Content analysis is a research method by using not haphazard and not subjective way to draw a conclusion to a specific situation based on spoken records, seeing related records or transcription (Downe-Wamboldt 1992). The author first read through all the articles which were selected at least twice in order to understand in depth. Only using real robots and carry out by human-machine contact researches were included. Researches that without real human-robot contact, for example, using only video/PowerPoint demonstration or interview were excluded. By using the critical appraisal tool Greenhalgh and Donald (2000), the author evaluated every selected article according to their researching method, the way how the research operated, and research findings systematically to check the validity. As the

critical appraisal tool (Appendix 2) was only a method to help readers to think in a more complete way, there were no specific scores to determine to choose the article, the author made self-determined inclusion criteria of meeting at least 2/3 criteria.

Then the author summarized all the articles, made a list of all the selected articles into one list (Appendix 1) including the title of article, authors and published year, research method, target people, sample and results in order to obtain a detailed understanding of each article, clarifying the advantages and disadvantages of them. Among selected articles, the author found one article which had a more complete detail description in research method, in both robot and tested participants, also intimate result analyze, got a higher score in critical appraisal tool, publisher has a higher ranking all over the world and had a more complete description were marked as core articles.

Core articles were used as a “frame”. Then recording each article in different special colors, different articles were placed in different new word documents. Then the author carefully reading context of every research, most of the selected articles were using qualitative as research method so there were many different pieces of thoughts and opinions, the author added all the articles which shared a similar “attitude” change comparing elderly’s attitude before real contact and after real contact together in one category. As a result, it came to be three kinds of attitude change, which are from a positive attitude to a positive attitude, from a neutral attitude to a positive attitude and from a negative/neutral attitude to a negative attitude. Then the author analyzed all the details, finally found three trend types, in other words, positive change, keeping the neutral and negative change. If there were something that showed a totally opposite opinion towards one certain category afterward the author tried to seek back to research design and process, to find out what lead that contradiction happen, interpret by comparing and discussing in a deeper way to analysis why two pieces of researches showed differently. In this procedure, the influence factors began to emerge. Through analyzing different resources and exploring the influence factors, the author logically synthesized and inducted them in results and conclusion.

7 FINDINGS

In all 7 selected articles, a total of 160 elderly participants were researched with an age range from 49-95 years old. Due to different research methods, 121 person-time of female and 50 person-time of male were included. Researches took place in New Zealand, France, the USA, Canada, Italy, Holland, and Belgium.

7.1 Elderly people's attitudes change towards the humanoid assistive robot

There were 3 themes in terms of theory to describe how elderly people's attitudes towards humanoid assistive robots changing before real contact and after real contact. Related articles marked as below in Table 3, author and publish year listed on the right side.

Table 3. Elderly people's attitudes towards humanoid assistive robot changing before real contact and after real contact

Attitude before real contact	Real contact	Attitude after real contact	Article (authors and publish year)
1.Positive	→	Positive	Cavallo et al. 2018; Döring et al. 2016; Louie et al. 2014. Stafford et al. 2014
2.Neutral	→	Positive	Beuscher et al. 2017; Schroeter et al. 2013
3.Positive/ Neutral	→	Negative	Wu et al. 2014 Stafford et al. 2014

In Table 4, the author listed how the elderly person's attitude changes after having a real contact with the robot and impact factors. Three different change themes: positive change, keep the neutral and negative change.

Table 4. How the elderly person's attitude changes after having a real contact with humanoid assistive robot and impact factors

Humanlike appearance	Positive change	How the elderly person's attitude changes when having real contact with the robot
Suitable shape and color		
Screen control for technological familiar participants		
Fluent control system and sensitive user detector		
Good verbal control		
Pat-like reaction		
Sufficient explanations, instructions, training and support		
Close to the robot, with assistant		
Choose to use robot initiative: longer interact time		
Higher previous education level		
Previous technology experience		
Balanced perceived mind and mind agency		
Long interval time between each robot-human interact	Neutral	
Previous education level(if robot designed as easy to use)		
Previous technology experience		
Gender and age		
Free choice of service		
Robot's appearance either close to humanlike or machinelike	Negative change	
Screen control for less technological participants		
Not reliable control system and error-prone user detector		
Less developed verbal control		
Live Independently(with high previous education level)		
Less technology experience		
Ethical problem, financial and private consideration		
Stigma		

Unbalanced perceived mind and mind agency		

7.2 Factors influence elderly people's acceptance towards the humanoid assistive robot

According to the findings that the author listed factors influence elderly people's acceptance towards the humanoid assistive robot, they were: robot appearance design, robot function design, human-robot interact mode, personal background, concerns about robot and misunderstandings, perceived robot mind (Table 5). Those will describe in the following text in detail.

Table 5. Factors influenced the elderly's acceptance

Appearance: Human-like or machine-like, shape and color	Factors related to robot	Factors influenced the elderly's acceptance
Robot function design: screen control, user detector, system cooperation, speech and voice control system, non-verbal interaction		
Human-robot interact mode		
Personal background: previous education level, previous technology experience, gender and age	Factors related to the elderly person	
Concerns about robot and misunderstandings: ethical, private consideration, stigma, misunderstanding towards the trail		
Perceived robot mind		

7.2.1 Factors related to the robot

There were three factors related to the robot which influenced elderly's acceptance:

Appearance of the robot, robot function design and human-robot interact mode.

The appearance of the robot

Most of the participants describe the appearance of robot as "acceptable (Cavallo, Esposito, Limosani, Manzi, Bevilacqua, Felici & Dario 2018; Beuscher, Fan, Sarkar, Dietrich, Newhouse, Miller & Mion 2017; Louie, Mccoll & Nejat 2014), positive, satisfied (Döring, Richter, Gross, Schröter, Mueller, Volkhardt & Debes 2016), interesting, and pleasant" (Wu, Wrobel, Cornuet, Kerhervé, Damnée & Rigaud 2014; Schroeter, Mueller, Volkhardt,

Einhorn, Huijnen, van den Heuvel, van Berlo, Bley & Gross 2013), “easy to use” (Stafford, Rebecca, Bruce, MacDonald, Chandimal, Daniel, Wegner & Elizabeth 2014).

Human-like or machine-like

In Louie’s (2014) research, the character of human-like was appraised by all participants, two-thirds of participants like the robot could express different feelings in different facial impressions and different tones. Facial expression was commented as positive and very effective. One-third of participants liked a life-like appearance and good manner of robot. The result showed that elderly participants focus more on robot if it could communicate with users in a user-friendly way than if the appearance of the robot looks like a real man or not. (Louie et al. 2014.) Almost all the participants said robot was interesting, except in Wu et al. (2014), two participants complained the robot was so similar to the machine. Only one participant found the robot was ridiculed if it had been designed too close to the human being. (Wu et al. 2014.) Cavallo’s research result indicated, if the robot had a “head”, it could increase user confidence and promote interaction without giving rise to any negative reactions. Designer of robot Era originally supposed to give their indoor and outdoor robots some occupation like domestic workers or deliverymen. Unfortunately, participants gave a low score in appearance familiarity. People might not like innovation (Cavallo et al. 2018), also in Beuscher’s (2017) research, participants didn’t like or neutralizing to commercial robot having human-like characters. It might attribute to the experiment design. Unlike other experiments, participants could directly contact with the robot while in this research, participants in trial were set to sit a place located 6 feet distance from robot NAO, and the experimenter sit in workstation at the back of participants behind a one-way mirror wall but in the same room. Participants didn’t experienced direct contact with the robot, instead of that, they sit quite far away from NAO.

Shape and color

The sizes of robots were required according to their function places. Assistive robot which is mainly operating outdoor were not described as too big or too heavy. Participants expressed a high degree of trust to robot developer rather than hypothesis made before experiment that a robot should be sturdy enough to win users’ trust. When it came to indoor robots, the participants tended to hold a neutralizing attitude until they saw how the robot move at home in real then they might change their mind. The robot Era applied in this research had a height of 150 cm, which was smaller than normal adults, giving user a feeling of the robot was under human control instead of being controlled by the robot. No matter indoor or outdoor, robot with both good functional utilization and at the same time having an appreciating value was needed in order to live together with the human being in the

real world. Esthetic of a robot could increase the positive impact on participants. (Cavallo et al. 2018.)

Robot function design: screen control

For technological familiar participants, virtual keyboard and icons on the top or under the screen were easy to find and use. But when it came to those who have no idea about computer technology, it was another matter. They could not even find the icon that they need to press. (Schroeter et al. 2013.)

Robot function design: user detector and control system cooperation

The user detector was reported not hundred percent reliable. Robot detected wrong target, ignored the real user and moved to some other places seemed to be randomly, this confused robot users. (Schroeter et al. 2013.)

As the robot system contained many different control systems, some of them were not well developed yet, the harmonization of whole cooperation was more or less not good enough. Mainly reflected in frequently restart the robot to check all the module was under control. Mutual interaction severely interrupted by this manner. (Schroeter et al. 2013.)

Robot function design: speech and voice control system

A good speech and voice control system could increase the good impression of users, make robot-human interact more fluent. Verbal control was appraised as interesting (Schroeter et al. 2013), easy to use (Cavallo et al. 2018) and like a natural conversation between human (Louie et al. 2014). On the other hand, a less developed verbal communication system could be counter-productive. According to Wu et al. (2014), when participants interacting with Kompaï robot, due to ineffective verbal control management, 5 participants experienced disappointed and sense of failure towards robot, hence they were not willing to talk to robot actively though they knew that the robot was still in immature prototype stage and needed to be improved. 3 participants would rather using the touch screen to complete interaction with the robot. Kompaï robot provided a possibility that robot could communicate with humans verbally through this transformation in mind was very limited, it was still refreshing to elderly people. Lack of active communication capacity, a robot could appear to be cold-hearted.

Schroeter and his fellows (2013) also found verbal control in CompanionAble robot was far from satisfied. It was usual that when participants were taught how to communicate

with the robot under certain instructive words but not succeed. When trail conductors tried to repeat instructive words, the robot react later after several times attempt. When participants used the robot freely under a smart home environment, they almost gave up before trying it again and again. What's more, when participants and conductors talking with each other, the robot would react under some words randomly from their phrases, often had nothing to do with the original intention. Based on these reasons above, all verbal control systems were closed after the first day.

Furthermore, though Cavallo et al. (2018) found the verbal control system was reported as easy to use, the participants also gave some recommends on it to improve the system. Firstly, to enrich the vocabulary of robot especially synonym, so the robot could understand their words better; secondly, to increase robot self-status report, for instance, what the robot is doing or what it is thinking about even what will it going to do. Participants would rather know whether the robot understands their instruction or not than just sit there waiting for the robot to react both in silence confusingly.

Robot function design: non-verbal interaction

Other non-verbal interaction appeared to be useful also. Participants talked with the robot-like talking with humans (Döring et al.2016; Schroeter et al. 2013.) In a case study, Döring et al (2016) found all three participants gave the robot a nickname respectively, welcomed it when meeting and said goodbye to it when leave. Though the robot didn't have a voice detector and cannot react to voice, three participants insisted to talk with the robot actively. Although the small light on the robot twinkled randomly, they still thought it was an indication that the robot is thinking. They praised the robot if it did something successfully, felt sorry if the robot did wrong, and shouted to robot if it did several same mistakes. They showed care about the robot like it was a child and asked for what it is going to do next. The robot had so-called capacitance fur, which means the robot will purr if fur area is touched. What most obviously observed was when capacitance fur on the top of the robot was touched by accident, the participant would stop what she was doing to fondle the robot. Another participant's husband appeared to be afraid and kept far away from the robot until he noticed the robot can purr. Purring could reduce user stress and create an intimate relationship between user and robot. When the trail ended, one of participant pat the robot constantly to show his praise and courage. (Döring et al. 2016.)

Human-robot interact mode: before real interact

It was common that participants felt anxiety. Many participants expressed worries about they could not complete the experiment (Cavallo et al. 2018), afraid of breaking the robot (Beuscher et al. 2017), holding a doubting attitude towards the robot and suspecting what benefit the robot could bring to them (Schroeter et al. 2013). On one hand, robot showed ability to handle many different things evoke feeling of fear, elderly remained alert; one the other hand, elderly had had an initial image, which could originally rooted from movies, science fiction, and social media or even over-exaggerated news reporter, that the robot could remember, think and do more independently than what the robot exactly could do. As soon as they started to use the robot, this illusion would be broken by reality. (Stafford et al. 2014.)

Sufficient explanations and information about how to interact with a robot could effectively relieve the tension, at the same time, when participants felt less stress, they would think robot become easier to use and had less anxiety. In Döring's (2016) research, all participants were familiar with robot platform, received detailed instruction about robot test and got fully trained before trail (Döring et al. 2016.)

Louie (2014) emphasized the only demonstration before trail was not enough, training participants well was a good way to deepen understanding about the robot and lead to a better robot acceptance (Louie et al. 2014.) Some participants showed their interests and admire, even going so far as to start to think about how to help to improve robot develop when robot system setting in front of them was introduced (Schroeter et al. 2013). Less anxiety could also result from trail design if participants set to sit far away from the robot, or participants knew researchers were set somewhere nearby even they could not see them. Except for one case mentioned before, most trails were designed like this: participants were allowed to contact the robot directly meanwhile labor assistance always in some place near participants, participants would feel less anxiety and more confidence to interact with the robot. (Beuscher et al. 2017.)

Interact time

A general conclusion from Stafford and fellows (Stafford et al. 2014), those participants who choose to use robot initiative according to their willing, in other words, the robot-user group had an improved positive attitude when the trial finished. Compared to attitude before trial, positive attitude improved along with interact time grow.

Seven participants underlined it was important to get familiar with the robot and use it. After four interaction periods with the robot, most participants found the robot was easy to

use while three from mild cognitive impairment (MCI) group still had difficulties to use the robot. cognitively intact healthy (CIH) group didn't have a significant advantage in usability of robot compared with MCI group during the whole process but MCI group needed more time to complete a task when both of the two groups had a seven-day interval since the last interaction section. In later qualitative questionnaire result indicated that interact time will not affect acceptance. (Wu et al. 2014.)

Comparing two different research method, Stafford and fellows' (2014) research design had a general longer interact time, two weeks free contact with the robot, they could choose to either allow robot to visit their own house or use it freely in public corridor continuously without any unnecessary break (Stafford et al. 2014). While Wu et al. (2014) had only one-hour per week for four weeks interact time, which was four hours interact time in total and longer interval time between each interact.

7.2.2 Factors related to the elderly person

There were three factors related to the elderly person: personal background, concerns about robot and misunderstandings, perceived robot mind.

Personal background: previous education level

Previous technology of participants presented differently in search results. Cavallo et al. (2018) recruited participants who were chosen as non-cognitive impair disease and physically fit. They had an unevenness education level that varies from primary education to university degree. Three robots and six robot service systems were tested in three realistic conditions: at home, in the apartment and outdoors. Researchers drew a conclusion that those who had previous computer and internet using experiences gave a higher appraisal to CORO (condominium robot) and ORO (outdoor robot) because they could realize the robot was a connection, a link between homes and outside. This conscious could reply to how robots spread in the world, from outside to home step by step. Furthermore, a high education background let them think more open, to understand that the robot was a social entity. But no details about previous computer using experience were given. It was unclear, how the researcher know previous technology experience of participants. Mixed education level with technology experience together might lead results biased. (Cavallo et al. 2018.) Louie et al. (2014) also claimed that all the participants showed a positive attitude to the robot. They gave a possible suppose was that all of the participants had had at least bachelor's degree.

However, Stafford et al. (2014) argued there was no relationship between acceptance and previous education level in their study in Auckland, New Zealand, a non-profit retire village building supplied elderly care for 650 older people who could live independently. Many participants didn't have a high education due to war or poverty interrupted their normal pace of life, which seemed to be common in the past. While education level might neither fully reflect their experience of life nor the ability to learn new things. Since they all expressed this kind of opinion: the robot was designed as an "elderly friend" and easy to use.

Wu et al. (2014) had done their research in living lab condition robot trail in a small sample investigation in Paris, France. The elderly contacted with robot for one hour per week, four times in total. Although seven of nine participants had at least bachelor's degree, all of them expressed high satisfaction to robot but low attend in using robot at the moment, only a few of them said would consider using robot in the future, most of them held a hesitate even refuse attitude to use because they still lived independently and didn't see any reason to use robot to support their life.

Personal background: previous technology experience

Previous technology experience was tested and resulted in many different ways. According to Wu et al. (2014), one hour real interact time with robot per week, in total four-week lab-environment experiment, except two MCI participants had no computer experience before, all CIH participants used the computer regularly in their lives. Among all 11 participants, eight of them reported their aversion towards devices and technology. In addition, robot was described as not their "generation habits" and they would feel more familiar with ICT (information communication technology) hence easier to use it rather than using a robot.

However, Louie et al. (2014) argued that there was no relevance between previous computer experience and robot acceptance although one aspect of data collection was unclear. 54 participants took part in the robot demonstration scenario then questionnaires were given to all participants while only 46 of them completed and returned the questionnaire. But it was not mentioned that for what reason the rest of them, in other words, eight of participants didn't return the questionnaire. Missing questionnaires based on rejective or negative attitudes could lead search result biased. Participants had an unevenness computer level and 32 of them didn't contact any robot before and 14 of them have seen a robot in public science stadium. What's more important, all participants had at least bachelor's degree and received live demonstration before trial. Improved social interaction dimensionality, natural communicate skills that robot Brain 2.1 had both fluent in oral and

non-oral language could let participants feel comfortable. (Louie et al 2014.) Beuscher et al. (2017) had also confirmed by researching 19 participants that computer or laptop using experience has no statistical association with user acceptance.

Stafford et al. (2014) had done a small cohort study in retire village in Auckland, New Zealand. During two weeks trial period, 11 of 25 residents used the robot. In this group, those who use robot more often had a more positive attitude towards the robot than those who use less in follow-up interviews. And robot users had a higher technology experience than non-user in Mann Whitney U test. (Stafford et al. 2014.)

Personal background: gender and age

Gender and age were not relative factors with choice of using a robot or not in robot-user group (Stafford et al. 2014) or robot acceptance (Beuscher et al. 2017.) No matter how old participants were, both over 75 years and below 75 years, they all highly praised robot Era, except the first mentioned of two liked to use shopping and communication service of robot hence the robot could relieve more or less burden from their careers. Cavallo et al. (2018) gave a explanation about this result as a cultural difference, those over 75 years had a stronger family concept and wished family members can take care of them. Outdoor robot ORO got a higher score from male users for outdoor activities gained more traction from male users. (Cavallo et al. 2018.)

Concerns about robot and misunderstandings: ethical problem and private consideration

Some of the participants questioned about ethical and private problem as robot function included supervision and detector, which acted more or less as an observer, let them feel uncomfortable. They worried about their own life could be shared with other people thence had a risk of privacy infringement (Wu et al. 2014.)

Not only privacy but also ethical problem were questioned by the elderly too. First of all, if robot really could stimulate robot users to live independently. That was because some parts of living skills were replaced by a robot, the elderly would not make efforts to complete basic affair which impair their self-care abilities instead. Secondly, social relationship and interact with human beings could also be impacted by robot too. Using robots could become an excuse that children were not responsible to take care of elder and then reducing the visiting rate. If use robot was a way to reduce financial cost in elderly care, then the society would become dehumanization and cold if robots took too many rolls in looking after people. (Wu et al. 2014.) Last but not least, elderly were afraid of robot being unsympathetic towards human welfare, as best they can judge, or as the worst they can

judge, using violence to harm, forcing elderly users to follow instructions (Stafford et al. 2014.)

Even so many questions about ethical and private were raised from other researches, while in robot Era trail, participants reported that the robot would not cause these kind of problem because they took robot as a common electronic product, what's more, they could choose to use or refuse when the robot recommend them certain services. This kind of free choice didn't have more invasive feelings than other electronic communication devices, some of male participants joked that robot could be less bothering than their wives do. (Cavallo et al. 2018.)

Concerns about robot and misunderstandings: Stigma

After Wu and their team (2014) interviewed their participants, generally speaking, most of them didn't think that they were potential users of the assistive robot. There were three points that hinder their acceptance to robot. First of all, using assistive robot was connected with a negative impression of old, lonely and dependent, these characters were not their actual condition nor their identity. Assistive robots would help those who need physical support or handicapped without any capability and energy to live by themselves or absolutely isolated. Participants all considered them as not in need of assistive robot.

Concerns about robot and misunderstandings: misunderstanding towards trail

Recognition of robot influenced the elderly whether to use robot or not. Misunderstanding of participants showed up in two parts: doubt to purpose and methods of the trail; and cost of vigor or time. Though participants were informed about the whole process of trial, researchers still noticed some people could have taken part in this trial were holding misunderstandings. They evaluated themselves as someone who cannot help in efforts because they didn't have enough computer skills to cooperate with the robot. So explain beforehand to them the robot were designed for those people who have no experience in technology at all could help to set participants' mind relieved. (Stafford et al. 2014.)

With regard to cost and benefits, made sure participants knew exactly what effort they need to contribute in details, and informed they can give up at any period of trail even they agreed to take part in the trail. Also took elderly limited ability caused by aging and diseases into account, researchers needed to reduce the number of questions and made it as easy as possible. (Stafford et al. 2014.)

In focus group discussion after attending four times interaction sessions, participants posed questions about subsequent cost in using a robot: if the pension of buying a robot could be at least partially included in their previous social security; if renting a robot would

be better than buying one or not. Also later cost in robot maintenance and technical support would be a problem of concern. (Wu et al. 2014.)

Perceived robot mind

Stafford et al. (2014), unlike other researches, emphasized and discovered how the elderly react to robot function, they focused on robot user-perceived robot mind. Perceived mind was divided into two sections, one was mind experience and another one was mind agency. To explain this conception, to put it in short terms, feelings and emotions belonged to mind experience, ability to complete tasks, like to think or make a plan, self-control belonged to mind agency. People cognized the world around them by using perception, so animal and machine were different in the human mind. However, human used to personalize mind to non-living things, the reasons could be traced back to primitive society era. The results of the study had proved that the robot was accepted easily when it present as both high mind experience and mind agency, means robot can be judged by common sense, or both at a low level, means robot is just a machine. If robot lost the balance between mind experience and mind agency, for example, low mind experience and high in mind agency, people would refuse to use this prototype of robot since it showed no mercy and empathy to human welfare. (Stafford et al. 2014.)

8 VALIDITY AND RELIABILITY

Validity and reliability principles in this thesis were obeyed all the time from start to the end. The author consulted a book written by Aveyard (2014) as the main guide book and several supplementary guide books as supplementary to assist, using LAMK guidelines on graduation thesis to accomplishing thesis.

Utilizing search guide “researchKIT” offered by Lahden academic library and using LAMK digital academic library Masto-Finna as searching data resources to get access to full text articles, the author got access to the most essential database for robot field and made sure retrieval techniques were completed in an extended, broaden or narrow way according to research questions. As the author is still a nursing student, lack of essential knowledge of all kinds of research methods, all the articles were chosen as peer-reviewed and were chosen from scientific databases. The author avoided using unreliable or unclear information resources such as random searching method through the general searching engine. Selected articles were full text available in English version to make sure the author could understand in-depth. The author searched back to the original version if selected articles used secondary resources.

Critical appraisal tools were applied to make a direct and concrete quality evaluation of each article. But as Richard (2014, 147) mentioned in his book, if some conflicts appeared, the researcher should not select one of them by distinguish which one is the “right one” but to describe how the divergence came. So as the author did, critically evaluated every article but not too critical, not only list facts but also command advantages and disadvantages of each article in order to analyze, compare and synthesis objectively without personal judgment. All the research work and data the author had collected had been recorded precisely step by step in a logical way according to research questions, purpose and aim. (Richard 2014, 147-153.)

9 ETHICAL CONSIDERATIONS

In this thesis, reliability and honesty that The European Code of Conduct for Research Integrity (2017) mentioned research integrity principles were followed: reliability in making sure used researches as qualified, research design, methodology, the investigation to component parts into detail, along with method and resource adoption should be reliable; honesty in research procedure, unclear, incomplete and biased method should be abandoned (The European Code of Conduct for Research Integrity 2017, 4.)

Research misconduct clearly characterized as fabrication, falsification, or plagiarism in the whole thesis procedure (The European Code of Conduct for Research Integrity 2017, 8.) The author made sure used material and results were real and not made up falsely, the original source was always preferred. No manipulated materials and personal subjective views were used in this thesis. Results or text used were marked if they were cited from others in this thesis without violating the right of the original authors' intellectual property.

10 LIMITATION

In this thesis, the author only used LAMK digital academic library Masto-Finna as searching data resources to get access to full-text articles, which limited the number of selected articles. All selected articles were published articles, the author lack necessary data resource to find unpublished article or “grey literature”, as Aveyard (2014, 92) mentioned in her book that to choose only published articles might lead result of literature review biased, because journals tend to choose those articles showed a positive results rather than a negative or neutral results.

Moreover, the author who worked along in this thesis was still a nursing student without experience in research area, no other coworker partners, in a sort of sense, personal understanding towards selected articles could be biased due to this. Hence, the author used critical appraisal tools to help understanding and thinking critically to measure each selected article. While the author yet lacks an in-depth understanding of research fundamental principles and design method due to study experience, possibly mistakes might occur.

11 CONCLUSION AND FURTHER RESEARCH

The aim of this thesis is to find out factors that influence the attitude of the elderly towards human assistive robot. The robot has a potential ability in elderly care has been approved and could be a considerable solution to alleviate conflict between nursing shortage and world aging after reviewing. Different conclusions presented after real contact with the robot. Most elderly hold a positive attitude towards assistive robot. A robot could accepted both in human-like or machine-like, as long as the functions and autonomous were matched with robot appearance. Close encounter with a robot could raise a positive feeling towards robot. Positive impacts increased in consideration of assistive robot esthetic and utilization. Anxious and worries before contact with robot were normal, as old people got to know robot often from movies and science fiction, where robot was dramatically described exaggerated distortion. Sufficient pre-guide and explanation, training more than just simply demonstration remarkably reduced the stress level and eased the anxiety, sequentially smoothed the process of acceptance.

Gender and age were not related factors with acceptance. Previous education of the elderly showed differently in different articles. Some research concluded positively with education level but others hold a thought of education could not fully reflect the cognition and knowledge towards robot. Technology experience was almost the same. But all in all, the assistive robot should be designed in an easier way for elderly to use and sufficient pre-use guide in place. When they had met some problems during using the robot, they could receive timely technique support.

Health care providers, especially nurses, are the closest personnel to elderly in health care settings, providing enough information in detail about robot beforehand/ afterward, and adequate pre-training before robot appliance to them also essential to succeed in applying new technology. Continuously information support is so important in robot acceptance, if health care provider could take part in the first robot introduction in a positive attitude with the patient and keep give support both technically and psychologically in later period, for example, help patient when they forget how to operate, encourage them when they get frustrated by new technology, guide and explain how to use the robot when elderly afraid of breaking the robot down, could make a great contribution to elderly robot acceptance. But the relevance still needs further study. Assistive robot had the potential ability to help nurses in heavy and busy working life, alleviate occupational burnout and contribute to solve world nurse shortage.

Prolonged contact time with a robot was also a good way to get familiar with robot, better than several short contact times in a long period because some of the elderly had memory disorder expressed they will forget some control skills during non-contact time.

Screen control for those who didn’t have a technology background were very hard to use, but voice control was highly appraised, if it could function well, it could be very convenient and user-friendly.

Some of the elderly pressed their worries about stigma and ethical problems. Assistive robot company could lead them to feel under supervision and uncomfortable. In the future, relevant government should complete the law of supervision and publicity of robot even positive and lovely advertise of robots are ways to ease these concerns.

The author noticed that all the research investigated real contact between a socially assistive robot and human were conducted in developed countries. Developing countries are different in background, have a large market and populations in robot applications. Advice for future research is to put more energy on developing countries, investigate how people react to robot under different culture background.

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12 APPENDICES

12.1 Appendix 1

Research article chart

Title	Authors and year	Robot type	Research method	Target people	sample	results	Appraisal score
Acceptance and Attitudes Toward a Human-like Socially Assistive Robot by Older Adults	Louie, Wing-Yue Geoffrey, Derek McColl, and Goldie Nejat. Acceptance and attitudes toward a human-like socially assistive robot by older adults. Assistive Technology. 2014	Brian 2.1 human like socially assistive robot	Quantitative research, demonstration and questionnare	Elderly, 62-91y with average 76y	56 at first demonstrate, 46 returned questionnaire. 37 female and 9 male.	Attitude to robot were mainly positive, human-like voices, facial expressions combined with easy to use and prior physiological training can lead to a better perceive results. Previous computer experiences didn't affect acceptance.	Reached at least 2/3 critical appraisal checklist.
Acceptance of an assistive robot in older adults: a mixed-method study of human–robot interaction over a 1-month period in the Living Lab setting	Ya-Huei Wu, Jérémy Wrobel, Mélanie Cornuet, Hélène Kerhervé, Souad Damnée, Anne-Sophie Rigaud, 2014	Kompaï robot	Mixed method. Real contact for longer period, questionnaire, semi-structure interview and focus group	Elderly, 76-85y with average 79.3y.	6 MCI and 5 CIH were investigated. 9 female and 2 male.	Satisfied with experience but low intention in using a robot now. Negative attitudes towards robot despite longer contact time and previous technological experiences with robot.	Reached at least 2/3 critical appraisal checklist.

Robotic companions for older people: a case study in the wild	Döring, Nicola, Katja Richter, Horst-Michael Gross, Christof Schröter, Steffen Mueller, Michael Volkhardt, Andrea Scheidig, and Klaus Debes. 2016	Companion type robot, humanoid	Case study, observing team, field notes, semi structured interview and robot recording to collect qualitative and quantitative data	Home living elderly.	67y male, 85y and 78y female.	Three cases showed positive experience with the robot, especially when the robot react in a pet like way. All of them expressed a trend to use the robot in the future.	Reached at least 2/3 critical appraisal checklist.
Robotic Services Acceptance in Smart Environments With Older Adults: User Satisfaction and Acceptability Study	Cavallo, Filippo, Raffaele Esposito, Raffaele Limosani, Alessandro Manzi, Roberta Bevilacqua, Elisa Felici, Alessandro Di Nuovo, Angelo Cangelosi, Fabrizia Lattanzio, and Paolo Dario. 2018	Robot-erasystem, contained 6 robotic Services operated by multi robots in multi environments.	Quantitative research	Normal senior.	45 participants in total number, divided into two groups and interval of 3 months. Group 1 has 22f+13 m, group2 has 22f+10 m. 23 people participate in both group.	6 robot systems, three different robots: DORO, ORO, CORO were tested in domestic living condition, condominium and outdoor. Result showed generally positive attitude to robot.	Reached at least 2/3 critical appraisal checklist.

Socially Assistive Robots: Measuring Older Adults' Perceptions.	Beuscher, Linda M., Jing Fan, Nilanjan Sarkar, Mary S. Dietrich, Paul A. Newhouse, Karen F. Miller, and Lorraine C. 2017	Humanoid robot NAO	Mixed method survey	Older than 65y, with enough ablity to complete test.	19 participates, 11 (6f+5m) age ranging from 66-94, take part in one-on-one interaction. 7 normal and 4 had MCI or demented. 8 take part in dual interaction (5f+3m), age from 70-86. White and high education level.	Overall assistive robot is accepted, changing from pre-test neutral to positive in post-test period. Age, gender and technology skills have nothing to do with robot acceptance but education year did related to global attitude. In the study participants showed low level of anxiety and fear which contrary to other previous study. Explained as it may because of experiment procedure and small sample.	Reached at least 2/3 critical appraisal checklist.
Realization and User Evaluation of a Companion Robot for People with Mild Cognitive Impairments	Schroeter, C., Mueller, S., Volkhardt, M., Einhorn, E., Huijnen, C., van den Heuvel, H., van Berlo, A., Bley, A. and Gross, H.M., 2013	CompanionAble robot	Qualitative research	older people who have mild cognitive impairment (MCI) and living (alone) at home	Six couples 11 participants in total, age ranged from 49-80. Primary users are MCI and familiar with technology.	After living with robot in smart environment for two days, the primary and secondary users hold positive attitude towards robot.	Reached at least 2/3 critical appraisal checklist.

Does the robot have a mind? Mind perception and attitudes towards robots predict use of an eldercare robot	Stafford, Rebecca, Bruce, MacDonald, Chandimal, Daniel, Wegner & Elizabeth.2014	Health-Bots	Cohort study	Elderly live in a retire village in Auckland, New Zealand. They are living Independently	25 participants, aging from 79-95, average 86.12. 18 female and 7 male.	Two weeks real contact with robot, they can choose to allow robot to visit their apartment or use it freely in public area in retire village. 14 of them didn't use robot at all and 11 used at least one of two choices. Perceived mind experience and perceived mind agency need to keep a balance either high or both low.	Reached at least 2/3 critical appraisal checklist.

12.2 Appendix 2

Critical appraisal tool

CRITICAL APPRAISAL CHECKLIST FOR QUALITATIVE OR QUANTITATIVE

RESEARCH ARTICLES

(Greenhalgh, T. & Donald, A. 2000)

1. Did the study ask how or why something was taking place (qualitative study), or what effect did something have on a studied sample (quantitative study)?

2. Was there a clear there formulated question?

3. Was the method of sampling adequately described?

4. Did the investigators study a representative range of individuals and settings relevant to their question?

5. Were the characteristics of the subjects defined?

6. Has the researcher taken their background and perspective into account in the analysis?

7. Have appropriate data sources been studied? Was literature review conducted?

8. Were the methods used reliable and independently verifiable? Audiotape, videotape? Was more than one method of data collection used?

9. Did the author use systematic methods to reduce their own biases influencing the results? Did more than one researcher perform the analysis? Were explicit methods used to address negative or discrepant results?

10. What are the main findings of the research? Are they coherent?

11. Are the results credible? Are they consistent with the data?

12. Have alternative explanations for the results been explored and discounted?

13. What were the author's conclusions? Were they consistent with the data and results?

14. Were the subjects in the study similar in important respects to our own patients?

15. Is the context similar to our own practice?