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Machines with Heart: Utilizing an STS Framework to Analyze Implementation and Design of Social Eldercare Robots in Germany and Japan

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Introduction

An oxygen tank pushed aside the family photos on the nightstand, its whirr like the angry breath of a monster. I walked in to see the warm bed in which my grandma read me bedtime stories stowed away, replaced with a cold metal hospital cot, wires spilling from the sides. Parkinson's disease had transformed my grandfather's living space into something I no longer recognized. I could not shake the feeling of how invasive and frightening the medical technology felt in that room.

Years later, when I began my studies in *Science, Technology and Society* (STS), I was surprised to discover the existence of social eldercare robots (which I will call SER).[1] In contrast to my personal experience in eldercare environments, eldercare robots appeared to provide a joyful caretaking experience, working symbiotically with patients and staff. Clips of older adults playing with robotic dogs intrigued me. An image of a lady exercising alongside a tiny robot man made me smile. One video struck me the most: of a man with a similar condition to my grandfather. As he held a robotic seal, he smiled and the brightness in his eyes seemed to return for a second.

Of course, the doubt set in, what if realistic robots are unsettling to patients with dementia? What if the sensors affixed to the robots are collecting data on the patients? Are the robots a beneficial healthcare tool? I grew curious about why people choose robots to take part in the care process. Access, cost, and availability are clear factors, but what makes people *comfortable* with a robot? What makes a robot thrive in a caretaking environment? This thesis will investigate three socio-cultural factors that impact the implementation and design of

[1] I use the term Social Eldercare Robots as it is the most fitting name for the context of my research. SER are typically referred to as Social Companion Robots, Social Robots, or Socially Assistive Robots in Academia and popular discourse. Socially Assistive Robots implies the robot is not social itself, which is why I chose to use the term Social Eldercare Robots instead.

eldercare robots in institutional caretaking settings: prevalence of service/therapy animals, migrant labor in the care sector, and attribution of a spirit to non-humans (animism).

Defining Social Eldercare Robots and Geographic Focus

Eldercare robots are autonomous or semi-autonomous devices designed to assist in the caretaking process of older adults. Anything from a remote-controlled food delivery device to an exoskeleton to assist with walking is an eldercare robot.[2] Within this category, there is a subset of robots called social eldercare robots. Social eldercare robots exist in human social environments. They must adapt to social norms, interact with people, and connect with the environment around them.[3] SER can have humanoid, zoomorphic (animal-like), or disembodied forms (i.e., chatbots).[4] While SER do execute specific tasks, they also gracefully adapt to the social atmosphere with a sense of flexibility: mirroring patient emotions in a way that is individualized to every interaction. For example, a robotic dog will wag its tail if petted by one person, and sulk if a different user raises its voice.

Eldercare robots are used around the world though their popularity differs dramatically depending on location. Their market value is estimated at approximately 2.25 billion US dollars as of 2023.[5] Note that this statistic can be a bit misleading, as it does not indicate the value for *social* eldercare robotics. For example, a remote-controlled food delivery robot is still an eldercare robot, but not social. SER have been studied in Japan, Europe, North America (the US and Canada), and Hong Kong.[6] SER are used in both home care, and institutional settings. They can be implemented outside of eldercare environments too, such as in pediatrics, or even

[2] Cyberdyne, "The World's First Wearable Cyborg 'HAL.;"
[3] Dautenhahn, "Socially Intelligent Robots," 684.
[4] Ghafurian, Lakatos, and Dautenhahn, "The Zoomorphic Miro Robot's Affective Expression Design and Perceived Appearance," 945: Laban et al., "Tell Me More! Assessing Interactions with Social Robots from Speech," 139.
[5] Future Market Insights, "Eldercare-Assistive Robots Market Outlook (2023-2033)."
[6] Yu et al., "Use of a Therapeutic, Socially Assistive Pet Robot (PARO)," 2.

astronaut training.[7] I will only study SER in institutional settings for older adults, i.e. nursing homes, assisted living residences, and rehabilitation facilities to narrow the scope of this research.[8] This thesis will primarily analyze PARO the harp seal robot (developed in 2003 by Takanori Shibata[9]) and Pepper the humanoid robot (developed in 2014 by Softbank[10]).

By researching *what influences the implementation and design of SER in different socio-cultural contexts* we can better understand how to make technology that is more effective, ethical, and personalized to user groups. Part of this idea is understanding the *success* of certain designs or methods of implementation of the robots. I define *success* as an overarching term to indicate certain qualities, described in the paragraph below. A robot may be successful in one area but fail in another. We see this theme of "trade-offs" in the discussion of a robot's ability to care in Chapter 4.

One form of success is that the robot must be actively used in an institutional setting. The robot has therefore effectively inserted itself into the social environment of the community. I also define success in part by the robot's ability to provide care (emotional, physical, spiritual care, etc.) to a patient. Finally, a robot can be successful in a longevity sense: it is used consistently and continuously. Evidence for success is documented in studies, documentaries, and patient/family anecdotes. I argue that SER find success in varying ways depending on external factors; the SER is a highly interpretively flexible technology. To make an effective claim about the implementation, design, and success of SER being linked to culture, I will study them in two

[7] Ryall, "Japan Tests If Sending Cuddly Robotic Seals on a Mission to Mars Could Offer Astronauts Stress Relief."
[8] Some people prefer the term "nursing home," others do not. Since it is the most used term to describe an assisted living facility in most of the literature I reference, I will use it. However, I acknowledge some individuals may not use the term in their daily lives.
[9] IEEE, "Paro - ROBOTS."
[10] Technology and Operations Management, "Softbank Robotics – World's First Consumer Humanoid Robot 'Pepper.'"

geographical contexts in which the eldercare systems are similar, but the local caretaking practices and are different: Japan and Germany.

This thesis is separated into five chapters. Chapter 1 provides background on the eldercare systems of Japan and Germany and the prevalence/use of SER in each country. Building off this, Chapter 2 looks in-depth at what makes a social robot *social*, and what specific effects it has on its users. Continuing forward, Chapter 3 analyzes how the form and role of SER is shaped by prevalence of service/therapy animals and immigration systems. Chapter 4 will examine how the goal of the SER is influenced by spirituality and animism. Lastly, Chapter 5 will provide concluding remarks and a summary of my analysis.

A Note on Source Materials

Social eldercare robotics are still a relatively propriety technology, and blind peer-reviewed studies on a variety of newer models are rare. Because of this, this thesis uses sources such as press releases and local news articles to provide supplementary information about social eldercare robotics. In addition, I consulted blog entries which highlight voices and perspectives that might not be featured in an academic publication. I analyzed these supplementary sources alongside established STS framework literature, blind peer-reviewed studies, and publications on the eldercare sectors in Germany and Japan.

Chapter 1: Establishing Background and Prevalence

Introduction

As noted in the thesis introduction, Germany and Japan is the geographic focus for my thesis, as their eldercare infrastructures are similarly designed, but the prevalence of eldercare robotics in each locale is different. Germany and Japan both upheaved their statewide long-term care systems around the turn of the 21st century. This resulted in Germany and Japan's eldercare infrastructure becoming more accessible.[11] Both countries offer long-term care insurance (LTCI) which, when introduced, dramatically altered eldercare practices, and improved access of long-term care resources.[12] It also improved overall quality of eldercare facilities, giving Japan and Germany the reputation of being some of the best countries for those over 65 to live.[13]

The German and Japanese Long-Term Care Systems

Before the LTCI systems (specifically the residential eldercare systems) in Japan and Germany can be analyzed, it is important to understand the context of how each country established their systems.

Before the year 2000, Germany was home to the largest population of older adults (over 65 years of age) out of the G7 countries.[14] Only recently, in 2000, did Japan surpass this population percentage.[15] However, just three years prior, Germany did not have any long-term care insurance for their significant percentage of citizens over 65. During this time, the "German Social Insurance System" consisted of four pillars: Health Insurance, Pension Insurance, Unemployment Insurance, and Accident Insurance.[16] Because long-term care did not fall under

[11] Karmann and Sugawara, "Comparing the German and Japanese Nursing Home Sectors: Implications of Demographic and Policy Differences," 2.
[12] Nakamura, "Japan's Welfare for the Elderly—Past, Present, and Future," 10: Karmann and Sugawara, 6.
[13] Fisher, "These Are the Best and Worst Countries to Be Elderly."
[14] Karmann and Sugawara, 7.
[15] Karmann and Sugawara, 7.
[16] CareME2, "The Social Security System In Germany."

these four categories, 80% of German older adults utilizing nursing facilities were unable to pay for their own care.[17] Typically, part-time care centers can offer some reprieve from at-home care, while being cheaper than full-time nursing homes, however, these options did not exist in the country at the time. Families often faced a choice to keep their jobs or take care of their family members, due to the lack of long-term care options. People who wanted to keep working and could not commit to an informal caretaking position often sent their relatives to nursing homes prematurely.[18] When family members must give up their jobs for caretaking, it can cause resentment within the family.[19] In 1991, the German government recognized these problems and created long-term care insurance: officially implemented in 1995.[20] Through this system, Germany diverted a large portion of the costs of caring for aging individuals from the family to the state.[21]

Shortly after the implementation of the insurance, the number of people admitted to assisted living facilities increased, but so did the types of living facilities, allowing for more options and reduced stress on informal caretakers.[22] German residential care facilities also saw an increase in modernization and infrastructure improvements.[23] The number of both home-care and residential-care staff spiked as well and in 2002, a federal law increased training and standardization for those entering eldercare professions.[24] The different types of homes

[17] Geraedts and Heller, "Germany's Long-Term-Care Insurance: Putting a Social Insurance Model Into Practice," 376.
[18] Geraedts and Heller, 377.
[19] Iallonardo, "Caregiver Resentment Is Normal."
[20] Theobald, "Care services for the elderly in Germany: Infrastructure, access and utilisation from the perspective of different user groups," 13.
[21] Karmann and Sugawara, 13.
[22] Theobald, 18: Geraedts and Heller, 380.
[23] Theobald, 38
[24] Theobald. 42

(including non-profit and for-profit) are considered a "unified-nursing home sector" under German LTCI.[25]

In 2021, the number of people over 65 in Japan equaled nearly a third of the entire population.[26] The disparity of older adults to young people is expected to grow as the birthrate is the 11th lowest in the world.[27] The country experienced a striking increase of life expectancy over the second half of the 20th century, with the number of people over age 100 increasing from 153 individuals (in 1963) to 69,785 in 2018.[28] As a result, the institutional care system in Japan changed dramatically in a short amount of time. The Japanese government even had to stop providing silver "sakazuki" (sake cups) to centenarians, since the rising percentage of superaged citizens caused the cup distribution to be too costly. 100-year-old Japanese citizens now receive a smaller, silver-plated cup.[29]

When Japan first introduced social welfare in 1963, most families cared for older family members in intergenerational households. Nursing homes were highly uncommon for this reason. There was only a single "intensive care home for the elderly" in the entire country. However, only about two decades after the introduction of social welfare, the number of these facilities had grown to over 1,000.[30] The sharp increase in the number of facilities did not necessarily mean they became more accessible. Demographic changes and the "nuclearization" of families around the 1970s and 1980s meant that fewer people were living in intergenerational households, and the responsibility of caretaking often fell on daughters (or daughters-in-law).[31]

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[25] Karmann and Sugawara, 9.
[26] Statista, " Japan: share of population aged 65 and older 1960-2021"
[27] Statista, "Countries with the Lowest Fertility Rates 2021."
[28] Nakamura, 3.
[29] McCurry, "Japanese Centenarians' Honorary Gifts Hit by Austerity as Numbers Soar."
[30] Nakamura, 3, 4.
[31] Lawrence, "Health Care Facilities for the Elderly in Japan," 680. Farrell, "What Japan Can Teach Us About Long-Term Care."

As a result, the 80s saw a phenomenon called "Social Hospitalization," where elderly family members lived in hospitals (versus proper assisted living facilities) because hospitals were cheaper and more readily available.[32] Social hospitalization is viewed by some scholars as a modern day version of the ancient Japanese practice, Ubasute, where adult children carried their aging mothers to mountaintops and abandoned them.[33]

To prevent this phenomenon and offer more resources to families in need of long-term care options, Japan introduced long-term care insurance in 2000, inspired by Germany's successful long-term care insurance program.[34] The public LTCI program is mandatory and funded by income-based premiums from individuals over 40 years of age.[35] As a result, nonprofit assisted living facilities in Japan became more financially accessible, with LTCI covering "90% of care costs."[36] For-profit nursing homes are considered a luxury and mostly utilized by wealthy clients who usually pay an upfront "lifetime rent."[37]

Both Japan and Germany saw a similar reason for the need of LTCI. Family structure changed, and intergenerational households grew to be uncommon. Many families felt no choice but to send older adults to nursing homes, or in the case of Japan, hospitals (social hospitalization). In addition, when LTCI was introduced around the turn of the 21st century, Japan and Germany had nearly the same proportion of older adults in their respective populations (in 1999, Germany's percentage of older adults was 16.2 while Japan had 16.66[38]). When both countries adopted LTCI, there was a rise in the number of options for care, as well as governing

[32] Ministry of Foreign Affairs of Japan, "Social Security in Japan."
[33] Weller, "Japanese People Who Can't Afford Elder Care Are Reviving a Practice Known as 'Granny Dumping.'"
[34] Karmann and Sugawara, 2.
[35] Japan Health Policy NOW, "Japan Health Policy NOW – Long-Term Care Insurance."
[36] Karmann and Sugawara, 10.
[37] Karmann and Sugawara, 9.
[38] Statista, " Japan: share of population aged 65 and older 1960-2021": "German Population Aged 65 and Older until 2021."

standards for quality of care. In addition, LTCI covers a large portion of a patient's payments towards care services, in Japan this is 90%, in Germany it is 70%.[39] LTCI shifted responsibility of care payments to the government. While, the German state controls LTCI, in Japan, the responsibility mostly falls on individual prefectures and local cities.[40]

As G7 countries, Japan and Germany have relatively similar GDPs. While fluctuating in terms of closeness, the annual GDP of each country remains close, at 4.23 trillion and 4.06 trillion (rounded) respectively in 2022.[41] We also see economic parallels regarding the robotics industries of Japan and Germany. Their robot densities (robots per employee) are ranked #3 and #4 respectfully, amongst Singapore (#1), South Korea (#2), Germany (#4), Sweden (#5), Denmark (#6), Hong Kong (#7), Chinese Taipei (#8), the United States (#9) and Belgium and Luxemburg (#10), according to the International Federation of Robotics.[42]

Japan's prosperous robotics industry is in part motivated by Japan's shrinking working population, in which the total workforce is expected to decline by 40% in 2065 due to the superaged population.[43] Known for producing a high volume of industrial robots, Japanese companies also pioneered humanoid robot development in the 1970s and 80s.[44] In fact, Honda released P2, "the world's first self-regulating, two-legged humanoid robot" 1996. The invention of P2 by Honda, a private company, represented a turning point in which private companies started to engage in *humanoid* robot production (versus industrial).[45] Japan is also recognized for incorporating robots into unconventional spaces, such as hotels, airports, homes, and cafes.[46]

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[39] Karmann and Sugawara, 10, 11.
[40] Karmann and Sugawara, 14.
[41] Countryeconomy.com, "Country Comparison Germany vs Japan."
[42] International Federation of Robotics, "Robot Race."
[43] International Trade Administration, "Japan Robotics Industry."
[44] Ishihara, "Roboethics and the Synthetic Approach – A Perspective on Roboethics from Japanese Robotics Research," 52.
[45] Ishihara, 52.
[46] Quito, "A Japanese Robot Cafe Shows How Avatars Can Foster Human Connection."

This high volume of robots in social spaces has constructed an idea that Japan, as a nation, is more "accepting" or "trusting" of robots. While the aforenoted statistics show many robots are produced in Japan, the idea that robots are always more accecpted by Japanese people can lead to a "Techno-Orientalist" view of Japan, which is important to recognize before I continue my analysis:

Many forms of popular media, especially within the genre of science fiction, categorize Asian countries, particularly Japan, as highly technological societies and can perpetuate an idea known as *Techno-Orientalism.* Fueled by "Western anxieties about Asia's growing cultural influence and economic dominance" from as early as the turn of the century, Techno-Orientalism paints a stereotype that Asian people are "hypo- or hyper technological."[47] By labeling Asian countries and people as highly technological it perpetuates a sense of otherness, xenophobia and a sense of "dying American dominance," according to author Chloe Gong.[48] Many scholars echo these sentiments when making broad claims that robots in Japan are simply more accepted because they are not "feared" there like they are in the West."[49]

There are specific, objective instances when historians or engineers cite elements of Japanese culture as influences for their designs, or attributes to the country's systems (such as the immigration system) that allow for more efficient implementation or acceptance of robots (which this thesis will unpack). Broad stereotypes overlook these precise socio-cultural factors and instead perpetuate harmful narratives about technology. The fallacy of these claims is apparent in comparison with Germany, which also produces a high volume of robots, but does not face the same assumptions about robotic acceptance as Japan.

[47] Roh, Huang, and Niu, "Technologizing Orientalism (About this Book)."
[48] chloegong, "Techno-Orientalism in Science Fiction."
[49] Zeeberg, "What We Can Learn about Robots from Japan."

Germany deploys the highest density of industrial robots in all of Europe. The country accounts for a third of Europe's robot population.[50] Germany is also a leader in the growing industry of "co-bots," or "collaborative robots." These robots integrate with humans in the manufacturing process. Germany projected to sell more than 71,000 co-bots in 2025.[51] Yet, despite collaborative robots being popular, their popularity is not widespread. A study by Dr. Tim Hinks of the Bristol Center of Economics and Finance found perceived "life satisfaction" correlated with European participant's fear of robots. Those with a low life satisfaction were more likely to express fear working with and accepting robots, suggesting robots, (though economically important) are not fully accepted in the greater European Union at large.[52]

In Japan, eldercare robots are present in about 60% of assisted living residencies.[53] Note that this figure does not specify social robots, but is an umbrella statistic for any eldercare robot. Therefore, a robot to lift a patient, but not socialize with them, could be included in this number. In addition, many of the eldercare robots featured in Chapter 2 originated in Japan, such as PARO, Pepper, and Qoobo. Out of the 5,000 PARO seals in use around the world, 3,000 are used in Japan. [54]

In an online survey of 1,238 Japanese citizens over 40 years of age, over 80% viewed eldercare robots favorably, which is interestingly higher than the number of husbands who expressed a desire to take care of their aging wives, and percentages of wives who want to take care of their aging husbands (data gathered from the same survey).[55] In another study by the Japanese Cabinet Office, 61.5% of 1,842 participants reported a desire to use robots for "nursing

[50] Hannover Messe, "Automation & Sensor Technology."
[51] Germany Trade and Invest, "Fact Sheet - The Robotics & Automation Industry in Germany," 3.
[52] Hinks, "Fear of Robots and Life Satisfaction," 331.
[53] Stanford University, "Robots May Be the Right Prescription for Struggling Nursing Homes."
[54] Foster, "Aging Japan."
[55] The Japan Times, "Over 80% of Japanese Positive about Robotic Nursing Care."

care" and listed important qualities of such robots to be ease of use, cost effectiveness, and safety.[56] The Japanese government has spent over $300 million dollars (as of 2018) on developing the robots.[57] The overall positive sentiment of eldercare robotics according to surveys, high amount of national spending on such devices, and statistics showing prevalence of robotics in facilities demonstrates a high overall presence of the technology in Japan. Even Barack Obama received a special meeting with PARO during a 2010 visit to Japan.[58]

The attitude towards eldercare robots in Europe in general is much less favorable than Japan. According to a survey conducted by the European Commission, 86% of the 26,751 survey participants were "uncomfortable with having their children or elderly parents minded by a robot." 66% of these participants ranked "totally uncomfortable" with this technology.[59] Note that this survey is worded slightly differently than the aforenoted Japanese survey. The wording here indicates a fear of robots taking care of the participant's family, versus themselves. Nevertheless, the sentiment is still not positive here. While there is not widespread use of eldercare robots in Germany and unfavorable attitudes are quite high, German nursing homes are growing as a site of qualitative trials of the robots. The robust aging care infrastructure motivates testing and researching the technology.

In addition, Germany, as part of the EU, has strict data protection laws which also carry over into the robotics industry. The "General Data Protection Regulation," adopted in 2016, is categorized by the European Council as the "strongest privacy and security law in the world."[60] Given that social robots must intake a high volume of data from their surroundings to function,

[56] Kolstad et al., "Integrating Socially Assistive Robots into Japanese Nursing Care," 184.
[57] MIT Technology Review, "Inside Japan's Long Experiment in Automating Elder Care."
[58] CBS, *Obama Test Drives Japanese Technology*.
[59] Kolstad et al., 184.
[60] European Council, "The General Data Protection Regulation."

this GDPR could impact the legality of certain social robots, if they use AI or certain data collection methods.[61] Japan's "Act on the Protection of Personal Information (2005)" has been described as "similar" to the GDPR.[62]

Germany currently faces a staffing shortage in long-term care settings: 120,000 caregivers short of the national need.[63] The combination of a robust physical infrastructure but a lack of workers creates an ideal situation to consider eldercare robotics in Germany (though Chapter 3 will show there are significantly more migrant caretakers working in the German care sector vs in Japan). Several other European countries face a similar situation which is why the European Union has partnered with Japan in the creation of multiple programs funding eldercare robotic research, including Participatory Design in Robotics for Elderly Care (PADERO), Agile Co-Creation of Robots for Ageing (ACCRA),[64] and Robots for Ageing Well.[65] PADERO is a partnership specifically between Germany and Japan.

What initially sparked my curiosity about the geographical context of my thesis is that Germany's LTCI system inspired Japan's LTCI system, yet Japan uses more eldercare robots; why is this? I also selected Germany for a case study due to its representation in the 2011 documentary *Squeeze Me: Robots in Dementia Therapy*, an in-depth look at the implementation of PARO in a German Nursing Home. Over 40 German nursing homes use PARO. Though only a small fraction of the 3,000 PARO seals deployed in Japan (out of 5,000 globally), the (at least)

[61] European Data Protection Supervisor, "Robotics | European Data Protection Supervisor."
[62] Linklaters, "Data Protected Japan | Insights | Linklaters."
[63] Harris, "Aging Alone."
[64] European Commission, "Agile Co-Creation of Robots for Ageing | ACCRA Project | Fact Sheet | H2020 | CORDIS | European Commission."
[65] European Commission, "Robot-Era Project."

40 German nursing homes adopting robotic technology represents a potentially growing market.[66] Note the PARO seals are typically shared amongst residents.[67]

Conclusion

By being directly inspired from one another, the German and Japanese long-term care systems are a useful foundation for analyzing eldercare robots. Though the environments are culturally very different, systemically, there are many parallels. This allows SER research in the two locations to focus on what socio-cultural factors impact robotic implementation, versus factors related to the structure of the eldercare/long-term care insurance system.

[66] Reuters, "Aging Japan."
[67] PARO, "PARO Therapeutic Robot | Training."

Figures 1-4

Paro and Pepper

Figure 1. Two residents play with PARO. (Photograph from Montclair State University. Accessed April 27, 2023. https://www.montclair.edu/calendar/view-event.php?id=47474

Figure 2: Charging PARO Seals. (Photo by Kim Hyung Hoon, Reuters. Accessed through IEEE on April 2, 2023. https://robotsguide.com/robots/paro/).

Figure 3: Pepper Robot Exercise Class. (Photo by PADERO. Accessed March 6, 2023. https://www.research-in-germany.org/the-future-of-work/news-and-stories/padero-how-to-design-robot-solutions-for-elderly-care-challenges.html)

Figure 4: Barack Obama meets PARO. (Photo is captured from the video: CBS. "Obama Test Drives Japanese Technology." YouTube video, 2:06. 2010. https://www.youtube.com/watch?v=CfCTBOTHsVU.)

Chapter 2: Social Robots in Action: A Review of the Social Robot's Abilities and Effects

Introduction

"It was unbelievable to see him lifting his head, his eyes awake, and how he reacted to Ole. And with a tenderness, it was simply nice. And then I said to him, 'Oh Mr. Wittke, I really wish I could understand you, I'm sure you have a lot to say […] hardly anyone understands you, that must be terrible for you.' And then I said: "But maybe Ole?'

That's when he started crying. And then I stopped because I almost had to cry with him. He comforted me. I leant against Mr. Wittke, with Ole on our lap. We were sad together and comforted each other, it was simply nice. For me too. It was very nice for me too. And exceptional for Mr. Wittke."[68]

This interaction comes from the 2011 documentary *Squeeze Me: Robots in Dementia Therapy*, directed by Annette Wagner. The documentary closely follows a pilot program implementing PARO seals in The Bremen Dementia Home. The star of the film is a PARO called "Ole" (pronounced Oh-lay). Mr. Wittke, the patient in the aforenoted vignette, suffers from dementia, and struggles with communication throughout the documentary. When holding Ole, he makes small comments about his life such as how he remembers seeing seals in the ocean as a sailor.[69] PARO, in this case, enters the conversation between Mr. Wittke and Nurse Anke, enabling Mr. Wittke to temporarily regain his ability (or desire) to speak. This is a key component of what gives a social robot this "social" title.

What Makes a Social Robot, Social?

A social robot carries a special set of qualities. Philosopher Dr. Kerstin Dautenhahn describes these qualities eloquently in their paper: "Socially Intelligent Robots: Dimensions of Human-Robot Interaction." Though the definition seems to vary slightly between scholars, I chose Dr. Dautenhahn's description for this paper as it is comprehensive yet concise.

[68] Wagner, Annette, "Squeeze Me: Robots in Dementia Therapy - Video - Films On Demand," 16:21.
[69] Wagner, Annette, "Squeeze Me: Robots in Dementia Therapy - Video - Films On Demand," 15:55.

Social robots must be:

Evocative: Humans' "tendency to anthropomorphize" is embedded into the robot. This means humans may "nurture, care, or involve" with the robot.[70]

Situated: Robot must "perceive and react to" outside stimuli around environment.[71] For example, if a robot uses wheels, it must be aware of people it could potentially run into.

Sociable: The robot interacts with humans in a social environment, and follows social rules.[72]

Intelligent: The robot uses "human-style social intelligence." They engage with the user similarly to the way another human would. [73]

Dautenhahn adds that social robots generally must: "express and/or perceive emotions; communicate with high-level dialogue; earn models of or recognize other agents; establish and/or maintain social relationships; use natural clues (gaze, gestures, etc.); exhibit distinctive personality and character; and may learn and or/develop social competencies."[74]

Not every social robot may exhibit each of these qualities. For example, PARO squeaks… and only squeaks. This is not high-level dialogue. However, PARO is a social robot. It can express emotions, adapt to social environments, remember its name, amongst other skills. "Social robot" is also a relatively subjective term. For example, consider further communication abilities in a robot. Humans use many forms of communication, verbal and non-verbal. Take an "industrial robot" which does not speak with the user but still communicates information to them using visual or physical cues. Is this robot social? Some scholars say this is a gray area. However, for the context of this paper, I am excluding industrial robots from the *category* of social robots.

The Effects on the User of the Social Robot in Eldercare

Before I analyze the ways SER are shaped by their environments, I want to first describe some of the key effects the robots have on their users through a set of user anecdotes. The key effects: provoking speech, reviving memories, and biofeedback, represent different forms of care

[70] Dautenhahn, "Socially Intelligent Robots," 684.
[71] Dautenhahn, 684.
[72] Dautenhahn, 684.
[73] Dautenhahn, 684
[74] Dautenhahn, 684.

and paint a broad context of the general capabilities of the SER. Chapter 4 will analyze how conceptions of care are locally influenced.

I. Provoking Speech

One of the most heartbreaking symptoms of dementia is the inability to verbally communicate one's emotions. In the aforenoted anecdote, Nurse Anke describes how PARO provoked speech in Mr. Wittke, by somehow prompting him to verbally express himself more than usual. This effect is echoed in many different studies on PARO, as well as other social robots.

In 2020, a group of scholars from University of Bergen (Norway) Ritsumeikan University (Japan) and Linköping University (Sweden) completed a comprehensive case study of social robots in 3 Japanese nursing homes in 2019.[75] Two of the facilities were nursing homes and one was a day care facility (a nursing home where residents only visit for the day).[76] The study specifically focused on PARO, Pepper, and Qoobo (a headless cat-body shaped pillow with a moving tail[77]) in action, by interviewing nursing home residents and staff to examine the effects of the technology. Researchers found a wide range of both positive and negative effects from the social robots on residents and staff, including *provoking speech*. One nursing home worker in this study described:

I am constantly speaking to people who don't speak back to me, but at some point if they have Paro, they make a sound or say 'KAWAII' [kawaii means "cute" in Japanese]; so something is coming out, even if it is just a small sound, this is enough reaction for me because they don't speak anymore. [78]

[75] Kolstad et al., 184.
[76] Kolstad et al., 183.
[77] Yukai Engineering, "Qoobo・Petit Qoobo | A Tailed Cushion That Heals Your Heart."
[78] Kolstad et al., 185.

This reaction echoes the one of Nurse Anke. When patients speak *more* than usual due to robot interaction, it shows a sense of improved socialization.

In addition, PARO sparks communication in patients who rarely speak, *even if the sentiment of the communication is not positive.* For instance, a woman who was paired with PARO in a Danish program commented "stupid thing" when working with PARO. The woman had not responded to anybody in her community for "an extended period of time" until meeting PARO. Thus, despite her comments being negative, PARO still mediated the social environment and prompted some kind of communication.[79]

II. Revival of Old Memories

There is also documentation that social robots can prompt a user to reflect on their life. One key study on this subject, by Laban et al., examines whether embodiment of a robot (as a human, animal) or disembodied source (a voice with no physical body i.e. Siri) is a key to prompting the user to communicate with it. Laban and his team discovered that research participants were more likely to disclose information to a social robot than to a disembodied source.[80] These findings suggest that the key to prompting disclosure amongst a human and a social robot is the physicality of the social robot. The team also found that human participants spoke with a higher pitched voice to social robots rather than disembodied sources.[81]

PARO's inventor, Takanori Shibata provides this anecdote about a woman in the United States who reflected on her life when working with PARO:

U.S. Resident #1: A female resident in mid-stage dementia with no verbal communication for over a year joined several residents sitting around a table with PARO in the middle. The resident watched as others stroked and spoke to PARO. She showed no interest at first, and then she reached for PARO and pulled him toward her. She began stroking him and spoke about the farm

[79] Shibata et al., "Therapeutic Seal Robot as Biofeedback Medical Device: Qualitative and Quantitative Evaluations of Robot Therapy in Dementia Care," 2534.
[80] Laban et al., "Tell Me More! Assessing Interactions with Social Robots from Speech,"136.
[81] Laban et al, 147.

she grew up on and the animals she cared for. Since that time, she has shown minimal communication with staff and family, but more than she did before being introduced to PARO.[82]

III. Social Robots as a Biofeedback Device (Calming the Body)

PARO is an example of a social robot that has been analyzed in numerous clinical settings to gain certification of medical effectiveness. In 2009, the United States Food and Drug Administration (FDA) approved PARO as a "biofeedback device."[83] Generally, biofeedback devices are categorized as devices which help you become aware of and thus control different elements of your body, for example, your heart rate.[84] While PARO does not provide a written response or icon-based cue about the user's physical and emotional state (like a smart watch, etc.) PARO will react to the user pleasantly if treated calmly, or negatively if treated aggressively. Therefore, PARO's squeaks and body language provide feedback to the patient, which helps calm them. As a Class II home use device in the United States, PARO can be funded by some health insurance plans. In Europe, PARO is similarly approved as a psycho-physiological biofeedback medical device. In the case of Japan, PARO is approved as a device regionally. In Okayama-city, PARO is "designated [as an] applicable device of long-term care insurance."[85] PARO's lengthy set of approvals gives it a sense of structural legitimacy which allows it to be used successfully in some institutional settings.

Interestingly, despite PARO's international set of approvals, PARO is not consistently viewed as a medical device, and sometimes is viewed as more of a pet depending on the cultural context. Shibata found that PARO users in Korea and Japan were more likely to view PARO as a pet. He adds:

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[82] Shibata, 2533.
[83] Shibata et al., "PARO as a Biofeedback Medical Device for Mental Health in the COVID-19 Era," 3.
[84] Mayo Clinic, "Biofeedback"
[85] AIST, "AIST : HIIRI Topic Takanori Shibata."

In Japan and Korea, people put a higher value on PARO as a pet than they do as a therapeutic device. On the other hand, in the United Kingdom, Sweden, and Italy, people put a higher value on PARO as a therapeutic device than they do as a pet. In the United States and Brunei, people put a high value on both.[86]

This recognition is important because it shows that PARO's acceptance within its environment is dependent on how the user views it. If PARO is more valued as a therapeutic device, PARO may be implemented as a timed program where users can interact with it in "doses."[87] As a pet, PARO may live in a nursing home and can be used at any time, maybe affixed with a name tag or outfit (Figure 5). The differences in PARO's user relationships will be further explored in Chapter 3.

Shibata and his team discovered that a major factor influencing the user's *interpretation* of a robotic device was "a priori knowledge of a subject"[88] In the case of PARO, this refers to the user's preexisting knowledge of seals and robots within their environment, as evaluating the robot is "subjective."[89] Using the effects of the SER as background, we can now analyze the social construction of the robot's form, role, and goal.

[86] Shibata, 2530.
[87] PARO, "PARO Therapeutic Robot | Training." Hung et al., "The Benefits of and Barriers to Using a Social Robot PARO in Care Settings."
[88] Takanori Shibata et al., "Tabulation and Analysis of Questionnaire Results of Subjective Evaluation of Seal Robot in Seven Countries," 689.
[89] Takanori Shibata et al., 689.

Figure 5

PARO with a nametag[90]

Figure 5: A PARO seal. (Photo by Nat Geo Kids. Accessed April 27, 2023. https://kids.nationalgeographic.com/awesome-8/article/robots)

[90] This PARO is named “あやちゃん“ which means “Aya-chan” in Japanese. Chan is a typical honorific in Japanese which expressed endearment.

Chapter 3: Interpretive Flexibility of Social Eldercare Robots

Introduction

The key theme in this chapter is **social construction of technology** or **"**SCOT,**"** the idea that technology is physically and conceptually shaped by humans. The very function of technology is entirely determined by social forces. Dr. Wiebe Bijker created the SCOT framework in 1983, as part of the publication *The Social Construction of Technological Systems* (edited by Dr. Bijker, Thomas P. Hughes, and Trevor Pinch). Dr. Bijker, emeritus Professor of Technology and Society at Maastricht University, provided a fresh methodology for examining technology through a sociological lens using *case studies*[91] that were sometimes mundane or "low tech" (i.e., bicycles or Bakelite plastic).[92] These case studies demonstrated how sociality impacted the function and flexibility of technological artifacts. I like to use the example artifact of a key to demonstrate SCOT: *a key may exist because we as humans value privacy*.[93]

Of course, SCOT is not merely that simple. Closely linked with SCOT is the idea of **interpretive flexibility**, that a technology can simultaneously hold multiple forms depending on the social context.[94] Returning to the key example:

- To a guard: a key means security
- To a key seller: a key represents economic prosperity
- To a young couple: a key to their partner's apartment represents trust
- To a woman walking alone in a dimly-lit parking lot: a key between her fingers might not play the role of a locking device but a defense mechanism.

Each of the aforenoted people, the guard, key seller, starry-eyed couple, and woman in a parking lot represent *relevant social groups:* "members of a certain social group [which] share

[91] I use the term "case studies" in this context to represent detailed examples to make an STS argument.
[92] NTNU, "Wiebe Bijker."
[93] I created the case study of the key inspired by Dr. Bijker. Although he did not do a case study of a key in the work I have read, Bruno Latour did a case study of a special key called the Berlin key. You can find his fascinating analysis in Chapter 1 of *Matter, Materiality and Modern Culture*, edited by P.M. Graves-Brown.
[94] Bijker, Hughes, and Pinch, *The Social Construction of Technological Systems*, 40.

the same set of meanings, attached to a specific artifact."[95] The key is an interpretively flexible artifact, and its value is different amongst each of the relevant social groups. Because each relevant social group values the key in a distinct way, what is considered an appropriate design of a key might change in each group.[96] Every technology is interpretively flexible to some degree, though some more than others. Consider a very expensive telescope, for only one of which exists. This technology might only have a few user groups, and perhaps everyone values it in a similar way. I would argue this (hypothetical) telescope is not as interpretively flexible as something like a smartphone. A smartphone, on the other hand, has billions of users, all whom might shape their connection to it differently. A smartphone is super interpretively flexible. Given that SER are relatively new and expensive, one might think they are not very interpretively flexible. I argue otherwise. SER are used in geographically and culturally specific contexts, and in each context, the robots see success, or even failure, in varied ways. There is a wide network of relevant social groups: older adults, family members, caretakers, engineers, etc. in different locations (in the case of this paper: Japan and Germany). This chapter will focus on two case studies which examine how SER are deeply interpretive flexible. The first case study will investigate the SER's form: showing how the robot's design as an animal affects its adaptation as a "pet" or "therapeutic device." [97] The second will examine the role of the robot: how it is viewed as a replacement or assistant to a human. Each case study shows a nuanced example of how the SER is constructed by each user group.

[95] Bijker, Hughes, and Pinch, 30.
[96] Bijker et al., *The Social Construction of Technological Systems, Anniversary Edition*, 157.
[97] Shibata, 2530.

FORM: The Interpretive Flexibility of Zoomorphic SER

Dr. Bijker, states: "[…] there is flexibility in how people think of or interpret artifacts but also that there is flexibility in how artifacts are designed. There is not just one possible way or one best way of designing an artifact."[98] In the case of the SER, different relevant social groups with shared opinions or values shape the success of physical form of the technology. A helpful case study for this concept is the design of PARO as a zoomorphic SER.

PARO is modeled after a harp seal pup, but not by chance.[99] As briefly introduced in Chapter 2, Dr. Shibata asserts that a crucial factor in PARO's success is the patient's "a priori knowledge of the subject"[100] PARO's appearance is *carefully* selected to mimic a seal to maximize effectiveness and success via established experiences, as according to Shibata, "people are unlikely to have unhelpful memories of seals."[101] In his study "Cross-Cultural Studies on Subjective Evaluation of a Seal Robot" Shibata indicates religious differences and cultural prevalence of animal therapy as influences for PARO's seal design; a typical pet-type animal like a dog or cat may not feel as welcomed into an environment where residents are not accustomed to animal therapy, such as countries where animal therapy is less common.[102] In addition, certain religious views may label dogs, or piglets as "taboo" making a dog robot ineffective.[103]

The use of animal therapy as the status quo in a nursing home environment can also affect perceived usefulness of a robot with a zoomorphic form. If animals are already established to be helpful in a caretaking context, an animal-like robot may feel like a deceptive replacement.

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[98] Bijker, Hughes, and Pinch, *The Social Construction of Technological Systems*, 40.
[99] PARO, "PARO Therapeutic Robot | Photo Gallery."
[100] Takanori Shibata et al., 689.
[101] Griffiths, "How Paro the Robot Seal Is Being Used to Help UK Dementia Patients."
[102] Shibata et al., "Cross-Cultural Studies on Subjective Evaluation of a Seal Robot," 454.
[103] Shibata, 455.

This concern is voiced in the documentary *Squeeze Me: Robots in Dementia Therapy.* Theologian Christopher Scholtz, explains in an interview clip:

> During my investigations I realized that healthy people develop a mode of dual consciousness, when dealing with machines that simulate living beings. They have contact with a living being as well as a machine. They're aware they have both forms of interaction and that there's actually a contradiction. And if we transfer this to dementia patients now, it is difficult of course to keep this criterion because it is difficult to understand how dementia patients think.[104]

Scholtz's concern implies a hyper-realistic animal robot is a kind of ethical breech that is deceitful for a patient with dementia. However, when animal therapy is uncommon, the zoomorphic robot can be seen as a new and useful solution, without the use of actual animals (although some families might still be uncomfortable with the realistic nature of the robot).[105]

Animal therapy is particularly uncommon in Japan. According to Tomoko Hashizume, service dog advocate and head of Japan Service Dog Resource center: "People [in Japan] don't see service dogs accompanying disabled people as a necessity for them to actively participate in society, but more just as a well-trained dog...which is why [people with service dogs] often face rejection."[106] Systemic regulations make it difficult for people to rent apartments or enter restaurants with dogs, and in general, dogs are "not tolerated in public settings in Japan." In fact, there are only 1,000 service dogs in Japan as of 2021.[107] Of course, there could be dogs working informally that were not counted here.[108] Regardless, dog-friendly nursing homes are considered "unusual" in Japan.[109]

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[104] Wagner, Annette, "Squeeze Me: Robots in Dementia Therapy - Video - Films On Demand," 27:33.
[105] Yang, "Meet Paro, a Furry Friend to Dementia Patients."
[106] Lee, "Japanese Disability Advocates Hope the Summer Paralympics Showcase the Pawsomeness of Service Dogs."
[107] Lee.
[108] Omo, "End-of-Life Guardians." There is a recent April 2023 documentary, *End of Life Guardians,* which describes one nursing home which allows residents to keep their pets. The facility's main dog, "Bunpuku" stays with residents even after they have passed and is dubbed the mitori-inu ("dog that is present at one's deathbed"). However, this type of facility is rare.
[109] NHK WORLD-JAPAN, *End-of-Life Guardians - NHK WORLD PRIME*, 3:24.

Animal therapy is more common in Europe. In Germany specifically, the number of guide dogs is little over twice that of all service dogs in Japan (Germany's statistic only refers to dogs to aid in vision guiding).[110] There is no exact statistic for the total amount of service or therapy animals in Germany. However, there is historical precedence, as Germany founded the first guide dog training schools during World War I.[111] The number of blinded German soldiers created a need to establish a systemic guide dog training and distribution system in 1916. This system fascinated individuals from abroad, leading to adaptation of guide dogs in the United States, Italy, and the UK.[112] Unlike Japan, Germany has a historical connection to guide dogs, making the systemic use of such animals more accepted for over a century. This applies to use within the older adult community as well.

Understanding service/therapy animal history, and overall prevalence in Germany and Japan clarifies how preexisting beliefs about animals entering nursing facilities, as well as pre-established animal training sectors, may influence the construction and success of certain robot forms. A comparison of animal therapy in Japan and Germany is helpful context for understanding why PARO is viewed more like a pet versus a tool in certain contexts. It is also important for understanding that some community members within a more established service animal sector may have trouble connecting to PARO like they would with a real animal.[113] Of course it is important not to generalize overall sentiment of service/therapy animals in Japan and Germany. According to Dr. Kelly Lange, a clinical neuropsychologist who works with older adults in the US, individual staff can play a significant role in how animals are used in

[110] The Japanese statistic does not specify guide dog versus service dog, while the European statistic is for service dogs for the blind.
[111] European Guide Dog Federation, "Research into Number of Guide Dogs in Europe," 5.
[112] International Guide Dog Federation, "History of Guide Dogs."
[113] Wagner, Annette, "Squeeze Me: Robots in Dementia Therapy - Video - Films On Demand." 33:08

institutional settings despite overall national prevalence of therapy animals. Dr. Lange describes how the staff's personal connections with their pets might influence the overall use of animals in a nursing home.[114]

ROLE: The Social Eldercare Robot's Job, Assistant or Replacement?

Social eldercare robots' specific *roles* in the nursing environment are quintessential to their existence, it is what they are programmed to do. Two social robots with the same form might have different roles. For example, out of two humanoid robots of the same model, one might lead exercises, and other might hold an iPad to let patients call a nurse. The first robot has a more active caretaking role, the second plays a liaison role between a doctor and patient.

This section will highlight and analyze the **caretaker role**. Some humanoid robots, like Softbank's Pepper can assume a caretaker role. However, patient or institutional acceptance of Pepper as a *caretaker versus an assistant* to humans varies deeply by geographical context. This case study will show how immigration systems in Japan and Germany impact how SER are interpreted as caretakers or assistants. Even if the function of Pepper is the same, the discourse around Pepper as a "replacement" or "tool" is highly bound to discourse around immigration and migrant labor in each country.

While Chapter 1 asserts a sense of similarity between Germany and Japan's eldercare systems, one major difference between the two countries is the use of migrant labor within the eldercare system. While both countries utilize migrant labor for eldercare, only Germany's eldercare system relies on migrant labor. Twenty-five percent of Germany's eldercare workers are migrant workers (nearly 700,000 people),[115] whereas in Japan the estimate is around 3,500

[114] Lange, Personal Correspondence, March 30, 2023.
[115] Packroff, "Migrant Workers Keep German Care System Afloat, Say Experts."

workers.[116] In Germany, many migrant workers act as live-in nursing staff in home care, and are recruited through third-party agencies, many of which have been described as occupying a legal gray area due to lack of accountability for such care brokers to adhere to German labor laws.[117] Japan, on the other hand, has a much more controlled process for hiring caretakers from abroad; caretakers who apply to work in Japan from abroad are forbidden from working in private nursing facilities and must take extensive classes in Japanese culture and language.[118] Unlike in Germany, where most migrant workers perform in-home care, migrant workers in Japan are not allowed to work in home environments.[119]

A key difference regarding migrant labor in the Japanese and German eldercare sectors is the role of "cultural intimacy" in the nursing process. Sociologist Pei-chia Lan describes how the "training curriculum [for migrant caretakers in Japan] aims to bridge ethnic differences and temper the otherness of migrants."[120] In addition to Japanese cultural competency training, applicants for eldercare work in Japan must have full certification and training in their home countries. Lan further describes how the training program for migrant workers is so bureaucratic and expensive that in some years the number of applicants is less than the spots offered by the nursing home.[121] While it is extremely difficult for nurses from abroad to get residency in Japan, each PARO has a Japanese birth certificate signifying his birthplace: Nanto City.[122] PARO's birth certificate is unofficial, it is symbolic of the way robots are viewed with a sense of personhood in the care sector.[123]

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[116] Lan, "Contested Skills and Constrained Mobilities," 5.
[117] Nikolova, "Germany's Exploitative Care Model Is Finally Being Put on Trial."
[118] Lan, 5, 12.
[119] Lan, 10.
[120] Lan, "Bridging Ethnic Differences for Cultural Intimacy," 1039.
[121] Lan, "Contested Skills and Constrained Mobilities," 10.
[122] Šabanović, "Inventing Japan's 'Robotics Culture,'" 348.
[123] Professor of Human-Robot Interaction, Personal Correspondence. Human rights advocates expressed outcry over a similar situation, where the hyper-realistic humanoid robot Sofia was granted citizenship in Saudi Arabia- CIC

The lack of migrant (or immigrant) workers in Japan is cited as one of the reasons the Japanese government diverts funds to develop robot caretaking devices.[124] Opinions about migrant care workers are more favorable than general views about immigration in Japan.[125] Though one engineer at RIKEN Bio-memetic research center claims that robots are a better solution because workers from all over East Asia will remain scarce once Japan's neighboring countries face aging crises as well.[126] Another factor is cost. Robots can be cheaper than employee recruitment costs (which can cost up to 20,000 USD in Japan).[127] The immigration situation in Japan shapes the role an eldercare robot plays as a proxy for a human caretaker, as the rhetoric about the labor crisis, as well as SER technology, is centered on the lack of people fulfilling eldercare roles.

In contrast, Prof. Volker Wulf, head of the Participatory Design for Robotics in Elderly Care (a partnership between German and Japanese designers), discovered that robots as caretaker replacements are viewed less favorably in a German nursing home. Wulf and his team implemented Pepper in a nursing home for 10-weeks and found staff and residents preferred to view the technology as a supplementary tool versus a replacement for human caregiving. Patient trust was higher when a human was present during robot activities.[128]

We see opposite sentiments here. In the aforenoted study by Lan, caretakers in Japan were more anxious about workers from abroad being able to provide adequate care. In this study, German caretakers were anxious about *Pepper* being able to provide adequate care. Of course, we cannot generalize the two sentiments to a national level based on these two studies. For

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Saudi Arabia [@CICSaudi], "'It Is Historical to Be the First Robot in the World to Be Recognized with Citizenship.' Please Welcome the Newest Saudi: Sophia. #FII2017 Https://T.Co/Bsv5LmKwlf."
[124] TRT World, "Japan's Robots," 0:36.
[125] Davison and Peng, "Views on Immigration in Japan," 2578.
[126] Journeyman Pictures, "Could the Future of Elderly Care Be in the Hands of These Robots?," 4:15.
[127] Lan, "Contested Skills and Constrained Mobilities," 12.
[128] PADERO, "PADERO."

example, some Japanese nursing homes use a human assistant with Pepper.[129] Rather, each study provides a snapshot of how local values about caretaking and immigrant labor influence the role of the robot as an assistant versus a caretaker, or even if a human is present during robot operation. Pepper is not physically able to replace a human, but the rhetoric about Pepper doing so appears to be influenced by opinions on immigration, especially the role of "cultural-intimacy" within caretaking.[130]

[129] Lufkin, "What the World Can Learn from Japan's Robots."
[130] Lan, "Bridging Ethnic Differences for Cultural Intimacy," 1039.

Chapter 4: The Robot's Goal to Care

Even if the role (caretaker, assistant, communication tool) of the robot is agreed upon in certain contexts, the nuances of the robot's *goal* is also contingent on how concepts like care are conceptualized in different geographical areas. This chapter will examine the goal of all social eldercare robots: to *care,* and how this goal is integrated into the design process of the robot. To clarify, this goal is not the robot's in the sense the robot is sentient, but the stated goal of the robot's creator.[131]

There is an extensive amount of STS literature on the concept of care. *Care in Practice: On Tinkering in Clinics, Homes and Farms* highlights case studies which challenge or complicate preconceived notions of care. In Chapter 5, "Varieties of goodness in high-tech home care," author Dr. Dick Willems, focuses on medical technology and how the philosophical concept of "good care" applies to ventilators and oxygen tanks. Willems' concept of "good care" is derived from Finnish philosopher Georg von Henrik's Varieties of Goodness.[132] Applying a similar analysis of good care to eldercare robots shows how the cultural importance of certain Varieties of Goodness influence the design of the technology. We also will see how von Henrik's framework does not work as a one-size fits all approach and is limited to forms of care conceptualized in Eurocentric cultural and spiritual contexts.

Georg Henrik von Wright introduced the Varieties of Goodness in 1960, publishing a book of the same name in 1963.[133] Von Wright asserts that *goodness* can be defined in six distinct categories (though some scholars put these categories in groups or argue there are more subcategories):[134]

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[131] PARO, "PARO Therapeutic Robot."
[132] Willems, "Varieties of Goodness in High-Tech Home Care," 258.
[133] The Gifford Lectures, "The Varieties of Goodness."
[134] Ylirisku and Arvola, "The Varieties of Good Design."

- Utilitarian–*useful or beneficial*–such as a good wrench[135]
- Instrumental–*works well for a specific purpose*–a good hairbrush (works well for hair)
- Technical–*good skill*– "I am good at cooking"[136]
- Medical–good health, body functions properly–good eyesight[137]
- Hedonic–pleasurable (used in a general sense)–a delicious apple[138]
- Good of man/virtue/character–a good member of society–a good dad, a courageous soldier[139]

Dick Willems argues that Varieties of Goodness can be applied to analyze how technology cares, as well as the effectiveness of its ability to care, by creating a concept called "good care."[140]

A technological artifact can provide different types of good care. It can provide technical care (perhaps it has a long battery life), but it may not be effective at caring for a patient emotionally (perhaps it is uncomfortable to use), for example. Willems argues the way in which a technology can care for a patient is highly flexible, and two technologies can have the same *function* but provide care in different ways.[141] He illustrates this idea with nasal or transtracheal cannulas. Willems describes the nasal cannula as more natural (it does not require an operation to implement) but the transtracheal cannula is unnatural, but more effective (directs oxygen straight to the lungs). Therefore, transtracheal is "more good" from a technical/efficiency perspective, but the nasal cannulas are "more good" for patient comfort or quality of life.[142]

"Varieties of good care" is an essential framework to understand social eldercare robots, as for one, there is a hardware/technical side of the technology as well as a social side. They have

[135] The Gifford Lectures, "III."
[136] The Gifford Lectures, "II."
[137] The Gifford Lectures, "III."
[138] The Gifford Lectures, "IV."
[139] The Gifford Lectures, "VII."
[140] Willems, 258.
[141] Willems, 261.
[142] Willems, 261.

to be technically good to function but must have good virtue to make patients comfortable (i.e. a robot cannot insult a patient). Secondly, engineers must make choices or trade-offs of what forms of goodness to implement in the robot, just like doctors must decide which cannula is the most "good." The varieties of good care scientists choose to implement in social eldercare robot's design/function is highly bound to local contexts.

For example, take the chatbot Mei-chan, who is essentially a digital SER. Developed by Dr. Chisaki Miura and her team and tested during the COVID-19 pandemic, Mei-chan's specific function is to provide a "mind-monitoring" service. By sending texts to her older adult users inquiring about loneliness or energy levels, she can quantify their "inner expressions" and communicate mental health data to caretakers.[143] Chisaki calls this type of mind-monitoring, "kokoro-sensing" in Japanese.[144] Kokoro (心) is a spiritual concept in Japanese culture that is difficult to translate into English. My friend, Yuriko, a native speaker of Japanese, calls it "the heart that contains the mind and spirit."[145]

By placing a high value on kokoro-sensing, Miura implements a kind of good *spiritual* care that is very specific to a Japanese context. As an STS scholar, you must be cautious when applying a preexisting framework, like varieties of goodness, to your analysis as it might not be applicable to all social, spiritual, or cultural backgrounds. Willems work is successful from an STS perspective because it introduces new varieties of goodness and challenges pre-existing varieties. [146] Theories like von Henrik's must be adapted to a globalized world versus remain static in their original (European) context.

[143] Miura et al., "Assisting Personalized Healthcare of Elderly People," 2, 7.
[144] Miura et al., 3.
[145] Himoto, Personal Correspondence.
[146] Willems, 272.

Continuing on the topic of kokoro, we see that spiritual care is crucial in several robotic examples. Kokoro-care is not only embedded into the design of Japanese robots (or chatbots) but is used as an evaluative measure as well. Several roboticists in Japan cite kokoro as an evaluative measure to determine how lifelike their creations are. Hashimoto Suji, roboticist at Waseda University, says his goal is to give his robots kokoro, a spirit. Suji compares kokoro to rebelliousness and a self-driven energy in robotics:

> If in the process a robot rebels and hits me, with my nose bleeding I would probably rejoice in my heart, thinking, 'Finally, I did it. We've almost made it!' This is because a period of rebellion naturally precedes independence. [147]

Even the company Sanrio (famous for inventing Hello Kitty) has a robotics division called "Kokoro" which rents out hyper realistic robots to museums.[148] The idea of incorporating kokoro into robots is closely tied to the religious practice of "Shinto animism:" where both humans and objects can have a spirit. STS scholars Casper Bruun Jensen and Anders Blok claim that this specific religious idea is what makes robots so successful in social, even vulnerable (i.e. nursing home), environments in Japan as Shintoism is practiced in 80% of the country.[149] In their paper, "Techno-animism in Japan: Shinto Cosmograms, Actor-network Theory, and the Enabling Powers of Non-human Agencies" the scholars assert: "Shinto cosmograms offer an interesting vantage point for interpreting the immanent, affective, enchanting and enabling powers of non-humans in contributing to collective life."[150] Therefore kokoro is not only a form of good care which designers implement into SER, but also a concept that is locally embedded into the very production of many robots that may help them find success specifically in the Japanese context. While Shintoism is rarely practiced outside of Japan, religion strongly influences robotic trust in

[147] Livni, "This Japanese Word Connecting Mind, Body, and Spirit Is Also Driving Scientific Discovery."
[148] Kokoro Company, "Robot Rental | Copyright(c) Kokoro Company Ltd."
[149] Livni.
[150] Jensen and Blok, "Techno-Animism in Japan," 84.

other contexts as well.[151] This is important to recognize as societal stereotypes tend to label East Asian countries as more accepting of robots, as described in Chapter 1.

For example, Dr. Diana Loeffler et al. from the University of Siegen in Germany, researched how Christianity impacted perceptions of a gigantic robotic priest (equipped with moving eyebrows, light-up hands, and a reflective coating covering its body), fittingly named, BlessU2 (Figure 6). BlessU2 can be commanded to provide blessings using a touch screen.[152] Loeffler and her team explain that those who practice Christianity could feel uncomfortable with the robot due to the idea that its creation as a humanoid figure somehow violated the "alien of man from nature."[153] Christian values juxtapose animism as the human nature divide is strongly enforced. Loeffler adds:

> Moreover, Christianity, the dominant religion in the entire western hemisphere, explicitly asserts the superiority of man over the rest of the natural world, thereby creating a form of competition between man and machine. Therefore, studying the acceptance of robots in less accepting religious communities is currently an underexplored field.[154]

The researchers surveyed 1,923 church visitors and completed a comparative study with multiple robots with 41 religious female participants. In the first survey over half of the participants had a "positive" reaction to the robot.[155] In the comparative study, the three most popular reactions to both robots (BlessU2 and smaller robot called QT) were "joy, fascination, and admiration."[156] Löeffer's study shows that the so-called "Western-Eastern divide" is not a strict rule for determining robot trust. Even though the study took place at a Protestant church, survey responses echoed similar sentiments of Shinto animism. While Shinto animism appears to

[151] BBC, "BBC - Religions - Shinto."
[152] Volker Rahn, "Experiment BlessU-2 / Interactive Installation ("Blessing Robot") English Version," 0:01.
[153] Löffler, Hurtienne, and Nord, "Blessing Robot BlessU2," 571.
[154] Löffler, Hurtienne, and Nord, 574.
[155] Löffler, Hurtienne, and Nord, 569.
[156] Löffler, Hurtienne, and Nord, 581.

have a strong influence on robotics, studies like Loeffler's show it is not the main driving force of an increased prevalence of eldercare robotics in Japan. The BlessU2, though not an SER, still performs spiritual care with respect to Christianity.

Figure 6

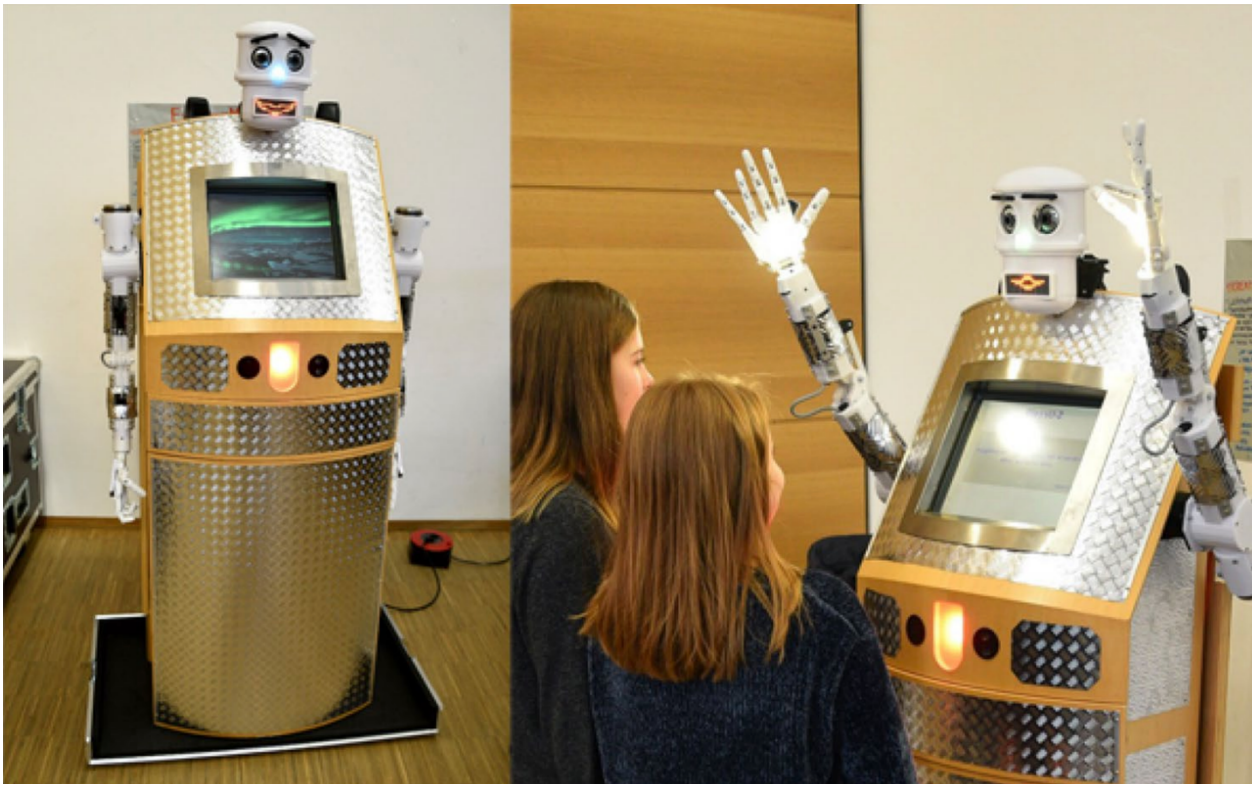

Figure 6: BlessU2 Robot. (Photo by Diana Löeffler. In *"Blessing Robot BlessU2: A Discursive Design Study to Understand the Implications of Social Robots in Religious Contexts," 575.)*

Chapter 5: Conclusion

Eldercare spaces are highly vulnerable and emotional environments. Successfully introducing a new technology into this environment requires a deep level of thoughtfulness and intercultural perspectives. By utilizing SCOT, we can understand how relevant social groups in Japan and Germany shape the design of social eldercare robots. As illustrated in this thesis, socio-cultural factors dramatically impact everything about the SER, from its design to its implication. The similar eldercare structures of Japan and Germany, yet differences in SER acceptance is strong evidence for the role culture plays in social construction of SER. We see this through case studies about animal therapy, immigration, and spirituality.

For animal therapy, prevalence of animals as therapeutic tools can impact perceived usefulness of an animal-like robot. When animals are not commonly welcomed in caretaking spaces, the role of a zoomorphic robot changes can change from a therapy tool to a pet. [157] In a community with a preestablished use of therapy animals, a robot can challenge the preexisting success of the animal, and cause wavering opinions from residents about whether the device is effective.[158] Regarding immigration, the use of migrant labor in a caretaking sector can impact rhetoric about whether a robot is viewed as a proxy for a caretaker, or an assistant to irreplicable human caretakers. This can in turn affect the role of the robot in a caretaking environment, performing tasks independently, or with a human present.[159] Lastly, spiritual factors can impact the way a robot performs care, as SER can be tailored to cultivate certain types of culturally specific good care, like "kokoro-sensing" in Japan.[160] Incorporating an STS framework into the design process to thoughtfully localize technology via intercultural

[157] Shibata et al., "PARO as a Biofeedback Medical Device for Mental Health in the COVID-19 Era."
[158] Wagner, Annette, "Squeeze Me: Robots in Dementia Therapy - Video - Films On Demand." 32:04
[159] PADERO, "PADERO."
[160] Miura et al., 3.

understanding is one way to ensure relevant social groups are included in the design process without relying on stereotypes. STS scholars must also understand the limitations of a pre-existing framework and how it might not apply to circumstances found in different communities.

I did not include my home country of the United States as a main geographic focus in my thesis as the eldercare system is so different from that in Japan and Germany. However, the United States does face a similarly rapidly aging demographic.[161] The United States is also one of the locations in which PARO is approved by a national regulatory body (the FDA), and used in nearly 100 facilities.[162] Further research on SER specifically in America could be beneficial as our eldercare system is particularly ineffective, expensive, isolating, and based off my personal experience, downright depressing.[163] We are one of the only industrialized nations without "a public system that covers eldercare."[164] Investigating how robots are accepted in American nursing homes, and whether they are effective could provide potential solutions for the United States' problematic eldercare sector. In addition, a further topic of interest regarding a United States lens is how family structure impacts trust in robotics. Dr. Kelly Lange, previously cited for her insight on animal therapy, further explains how she believes grandchildren are more open to incorporating unconventional or new treatments into their grandparent's care, vs adult children or spouses (who tend to be particularly reluctant). Why is this, and how does this relate to family structure-related issues like social hospitalization in Japan?

Our world is becoming more and more technologized whether we like it or not. However, if we include input from vulnerable user groups across different cultures when designing devices,

[161] Administration for Community Living, "2020 Profile of Older Americans."
[162] Shibata et al., "PARO as a Biofeedback Medical Device for Mental Health in the COVID-19 Era." PARO, "PARO Therapeutic Robot | North America Users."
[163] NBC News, "America Now Knows That Nursing Homes Are Broken. Does Anyone Care Enough to Fix Them?"
[164] NBC News, "America Now Knows That Nursing Homes Are Broken. Does Anyone Care Enough to Fix Them?"

technology will be more likely to be helpful and not harmful. The first step in doing this is to conduct research like this thesis, to understand *why* technology is successful or not across a variety of communities.

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