Informatics

Kulturelle Variationen in HAI

Einblicke von Japan und Österreich

DIPLOMARBEIT

zur Erlangung des akademischen Grades

Diplom-Ingenieurin

im Rahmen des Studiums

Media and Human-Centered Computing

eingereicht von

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Wien, 25. November 2024

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Cultural Variations in HAI

Insights from Japan and Austria

DIPLOMA THESIS

submitted in partial fulfillment of the requirements for the degree of

Diplom-Ingenieurin

in

Media and Human-Centered Computing

by

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Chiara Kanya, BSc

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Chiara Kanya

Danksagung

Ich möchte mich von Herzen bei meiner Betreuerin Astrid Weiss für ihre zuverlässige Unterstützung bedanken, selbst über 8.993 km Entfernung und 8 Stunden Zeitverschiebung hinweg. Ohne deine Geduld und wertvollen Ratschläge wäre diese Diplomarbeit nicht möglich gewesen, vielen Dank dafür!

Ein großer Dank geht auch an das JASEC der TU Wien und der Japan Student Services Organization (JASSO), die meine Arbeit gefördert und meinen Forschungsaufenthalt damit erst ermöglicht haben.

Mein besonderer Dank gilt zudem Tomoko Koda, dem OIT Human Interface Lab und dem Osaka Institute of Technology, die mich nicht nur unglaublich unterstützt, sondern mir auch eine unvergessliche Zeit und ein zweites Zuhause in Japan gegeben haben.

ありがとうございました!

Acknowledgements

I would like to thank my supervisor Astrid Weiss very much for her reliable support, even over a distance of 8,993 km and an 8 hour time difference. Without your patience and valuable advice this thesis would not have been possible, thank you very much!

I would also like to thank the JASEC of TU Wien and the Japan Student Services Organization (JASSO) for supporting my work and making my research stay possible.

My special thanks also go to Tomoko Koda, the OIT Human Interface Lab and the Osaka Institute of Technology, who not only provided me with incredible support, but also gave me an unforgettable time and second home in Japan. ありがとうございました!

Kurzfassung

In dieser Diplomarbeit wird der Einfluss von kulturellem Hintergrund und Aufgabenkontext auf unsere Wahrnehmung und Einstellung zu sozialen Robotern untersucht. Obwohl sich bisherige kulturübergreifende Forschung in diesem Gebiet bereits auf Vergleiche zwischen westlichen und östlichen Kulturen, insbesondere den USA und Japan [47] [7], konzentriert hat, gibt es in Österreich nur wenige Studien die sich mit sozialen Robotern beschäftigen. Darüber hinaus möchte diese Diplomarbeit das weit verbreitete Vorurteil widerlegen, dass die japanische Kultur die Einbeziehung von Robotern in ihr tägliches Leben besser akzeptiert als andere [40]. Stattdessen wird argumentiert, dass der Kontext in dem ein Roboter eingesetzt wird eine größere Rolle spielt als der kulturelle Hintergrund der Person die ihn benutzt (H1). Zusätzlich wird in dieser Diplomarbeit untersucht, ob Roboter in dienstleistungsorientierten Rollen besser akzeptiert werden als Roboter, die für tiefere soziale Aufgaben eingesetzt werden (H2).

Um diese Fragen zu beantworten, wurde eine kulturübergreifende Studie zwischen technischen Universitätsstudierenden aus Österreich und Japan durchgeführt. Ein SOTA-Roboter wurde in vier verschiedenen Rollen programmiert, um einen Hotelrezeptionisten, einen Kellner, einen Tutor und einen Begleitroboter für ältere Menschen zu imitieren. Da eine persönliche Interaktion zwischen teilnehmenden Personen und dem Roboter aufgrund der geografischen Entfernung nicht möglich war, wurde ein Online-Fragebogen mit Videos des Roboters erstellt und von 31 österreichischen und 30 japanischen Studierenden beantwortet. Um eine homogene Gruppe für den kulturellen Vergleich zu gewährleisten wurden technische Studierende, die seit mehr als zehn Jahren in Österreich oder Japan leben, ausgewählt. Zusätzlich zum Videomaterial wurden zwei standardisierte Fragebögen, GAToRS [36] und RoSAS [12], verwendet. Anhand dieser sollten tiefere Einblicke in die allgemeine Einstellung der Teilnehmenden zum Einsatz von Robotern gewonnen werden. Ebenfalls wurde damit getestet, wie ÖsterreicherInnen and JapanerInnen die sozialen Eigenschaften des SOTA-Roboters wahrnehmen.

Die Ergebnisse zeigen sowohl kulturelle Unterschiede als auch Unterschiede in Bezug auf den Aufgabenkontext des Roboters. Sowohl in Österreich als auch in Japan konnte eine deutliche Präferenz für den Begleitroboter für ältere Menschen gegenüber dem Tutor-Roboter festgestellt werden. In Bezug auf die dienstleistungsorientierten Rollen wurden jedoch der Rezeptionist- und der Kellner-Roboter von den japanischen Teilnehmenden als nützlicher empfunden. Darüber hinaus wird gezeigt, dass japanische und österreichi-

sche TeilnehmerInnen größtenteils ähnliche Einstellungen gegenüber dem allgemeinen Einsatz von Robotern haben. Japanische Teilnehmende zeigten etwas mehr Bedenken gegenüber der Interaktion mit Robotern auf persönlicher Ebene, während österreichische Teilnehmende eine etwas stärkere Zustimmung zu den gesellschaftlichen Vorteilen von Robotern äußerten. Ebenfalls empfanden die japanischen TeilnehmerInnen bezüglich des gezeigten SOTA Roboter mehr Unbehangen, als die österreichischen. Der Ruf, das Japan ein „roboterfreundlicheres" Land als andere ist, wurde in dieser Diplomarbeit also nicht bestätigt. Nachfolgende Forschungen sollten sich darauf konzentrieren den Grund hinter dem beobachteten kulturellen Unterschied in der Wahrnehmung von dienstleistungsorientierten Roboter Rollen, sowie Präferenzen innerhalb der sozialen Rollen aufzudecken.

Abstract

This diploma thesis seeks to examine the influence of cultural background and task context on people's perception of and attitudes towards social robots. Although previous cross-cultural research has already focused on comparisons between Western and Eastern cultures, particularly the US and Japan [47][7], studies specifically examining this topic in Austria remain limited. Further, this thesis wants to challenge the widespread believe, that the Japanese culture is more accepting of including robots in their daily lives than others [40]. Instead, it argues that the context in which a robot is being used has a greater influence on a person's attitudes towards it, than the person's cultural background (H1). Furthermore this thesis project wants to test, if robots in service-oriented roles receive better acceptance than robots being used for highly sociable tasks (H2).

To answer these questions, a cross cultural study was conducted between technical university students from Austria and Japan. A SOTA robot was programmed to imitate a hotel receptionist, a waiter, a tutor and a companion robot for the elderly. Since an in-person interaction between the robot and participants was not feasible because of the geographical distance, an online questionnaire including videos of the robot was created and answered by 31 Austrian and 30 Japanese participants. To ensure a homogeneous group for the cultural comparison, technical university students who had lived more than ten years in either Austria or Japan were chosen. In addition to the video material, two standardized questionnaires GAToRS [36] and RoSAS [12] were included. The aim was to gain deeper insights into the participants' general attitudes towards the use of robots and to assess how they perceived the social attributes of the SOTA robot.

The results of this thesis indicate cultural differences as well as differences in relation to the robot's task context. In both Austria and Japan a distinct preference for the companion robot for the elderly over the tutor robot could be observed. However, regarding the service oriented roles, the receptionist and waiter robot were perceived as more useful among Japanese participants. Furthermore, the results demonstrated that Japanese and Austrian participants mostly share similar attitudes towards the general use of robots. Japanese participants showed slightly more concerns about interacting with robots on a personal level, while Austrian participants expressed slightly stronger agreement with the societal benefits of robots. Moreover, the Japanese participants also reported feeling more discomfort about the displayed SOTA robot than the Austrian participants. Therefore, the Japanese reputation of being more "robot-loving" than others

was not supported by this thesis project. Subsequent research should focus on uncovering the reason behind the observed cultural difference in the perception of service-oriented roles, as well as preferences within the social roles.

Contents

CHAPTER 1

Introduction

During the 20th century, technological progress reached new heights as robots began to play a crucial role in various sectors. Besides their widespread use in the production industry, robotic research started imagining robots in more social and service-oriented roles. Those social robots were developed to support people in public sectors such as healthcare, retail, gastronomy, education, or offer assistance and companionship to people in their own homes [53][82][69]. Today the field of service and personal robotics is rapidly expanding, both in research as well as commercial sectors [55]. However, despite extensive research on the subject over the past decades, social robots have yet to find their place in our everyday lives. Why is that?

A significant challenge for the successful deployment of social robots, is having people accept them as a part of their daily life. Therefore multiple studies have focused on identifying factors that play a role in people's perception of and attitude towards robots. While the impact of robot appearance, personality and behavior has been extensively studied in previous literature, research has also shown that people's cultural background might significantly influence their perception of robots. In [54], researchers discovered that the preference for implicit or explicit communication style varies across cultures. A study by [3] investigated the impact of robot appearance. Their results revealed that some cultures favor functional-looking robots, while others prefer those with a more anthropomorphic design. Cross-cultural studies like these often tend to focus on comparing Western- (e.g. Europe and the Americas) with Eastern countries (e.g. Asia and the Middle East), because of their distinct social norms, communications styles, religious beliefs and media influences. Japan is frequently contrasted with other countries in HRI studies, as through it's long robot-related history it is considered as *The Robot Nation* [22]. Additionally, due to its rising problem of an overaging population and lack of nursing staff, the deployment of social robots is seen as a possible solution and therefore supported by the government [39]. Because of Japan's robot-loving image it is often believed that the Japanese are more acceptable of including robots in their daily lives.

However, studies have shown a quite different reality in which Japanese expressed more caution and concerns towards robots compared to other countries [7] [40] [75].

In contrast to the extensive research on Japan's attitudes towards robots, Austrian literature on the subject is relatively scarce. Therefore this thesis project seeks to enhance the overall understanding of attitudes towards robots in both Japan and Austria. Given the complexity and diversity in the HRI field, this thesis project focuses on two key aspects: Cultural background and task context. When exploring the acceptance of social robots it is important to consider the task context in which these robots operate. This aspect may significantly influence how willingly people accept robots, as previous literature has shown [65] [15] [55]. However, there is a shortage of research that specifically investigates the interplay between cultural background and task context. Understanding whether the nature of the task or the cultural context plays a more pivotal role in shaping acceptance can provide valuable insights for the integration of social robots into everyday life. Therefore, this thesis project seeks to illuminate the preferred applications of social robots and investigates possible cultural variations between Austria and Japan. At the same time, it will provide a deeper insight into the Austrian perspective on this topic.

For this cross-cultural comparison, an online questionnaire will be used as it effectively captures people's opinions and quantifies responses. Additionally, this method overcomes the challenge of geographical distance inherent in cross-cultural studies. Building on the findings of previous studies [27] [65], four different application scenarios using the same robot will be presented to both Austrian and Japanese participants through short videos. Through the evaluation of the data this thesis tries to answer the following questions: Does the robot's task context influence the participants perception of it? Does the participant's cultural background influence their perception of the robot? And what are the attitudes towards the use of robots in Japan and Austria?

The thesis is structured as follows: Chapter 2 presents an overview of the related literature, with the first part focusing on the definition, characteristics and application context of social robots. In the second part cultural differences in HRI are listed, observed by previous cross cultural studies. The third part gives a more detailed view into the situation in Japan and Austria. In Chapter 3 the research framework and hypotheses are described, followed by Chapter 4 which includes the thesis's methodology. Chapter 5 states the survey results while a discussion on each notable finding is presented in Chapter 6. Finally Chapter 7 concludes with a summary of the key outcomes and prospects for future work.

CHAPTER 2

Related Work

2.1 Social Robots: An Overview

2.1.1 Definition of Social Robots

Up until the early 2000s, definitions of robots were mainly addressing industrial robots and focused on function, productivity or the level of autonomy. However, there were already existing robots whose primary aim wasn't to enhance productivity, but rather to foster social interaction with humans. An early example and one of the first commercially available "social robots" is the robotic dog AIBO [64] that was introduced by Sony in 1999 (Fig. 2.1). A clear definition for these robots, that primarily focused on the interaction with humans, was needed. In the following three specifications that were introduced at the time, are examined in more detail.

Figure 2.1: AIBO original model ERS-110, example for a socially interactive robot. Reprinted from [20]

Socially Interactive Robots

In 2003 Fong et al. [20] proposed the term *socially interactive robot*, for robots that mainly serve the purpose of peer-to-peer human-robot interaction. Following the assumption, that humans want to interact with robots like they interact with other people, the authors defined special characteristics these robots should have. These included social features like being capable of showing and interpreting emotions, high-level dialogue, non-verbal communication, forming social relationships as well as expressing their own personality.

Social Robots

In 2004 another definition was introduced by Bartneck et al.: "A social robot is an autonomous or semi-autonomous robot that interacts and communicates with humans by following the behavioral norms expected by the people with whom the robot is intended to interact." (Bartneck & Forlizzi, 2004, p. 592, [4]). This definition includes autonomy as a requirement for a social robot. According to this definition, a robot that is entirely remote controlled cannot be defined as social, because it lacks autonomous decision-making capabilities. Next, the communication between human and robot is highlighted, as robots that only communicate with other robots do not apply as social robots. Last, the definition emphasizes that a social robot has to behave according to the social norms of its users. Being able to understand the values and standards that stem from the surrounding society and culture, is an essential quality of a social robot [4], as it lays the foundation for successful social interaction.

Socially Assistive Robots

While the definitions provided by Bartneck et al. and Fong et al. both include the element of interaction, they do not specify any particular objective for the interaction between humans and robots. In 2005, Seifer et al. [19] introduced the term "socially assistive robots (SAR)", describing robots that provide assistance to human users mainly through social interaction. At the time, most robotic related research only distinguished between contact assistive robots (robots that assist people through physical contact) and the social interactive robotics (robots that entertain people through social interaction) mentioned by Fong et al. [20]. Seifer et al. wanted to expand the research area of assistive robotics, by the rising field of robots that not solely entertained but assisted people through social interaction, without using physical contact [19]. As there exist a great number of usage scenarios where social assistance applies better than physical contact, the authors saw the need for a clear definition, introducing socially assistive robots as an intersection of assistive- and social interactive robots.

2.1.2 Characteristics of Social Robots

Drawing from the definitions above and other related research, literature has found four major design characteristics to describe the features of social robots: *Embodiment*, *morphology*, *autonomy* and *assistive role* [80]. In the following each of these characteristics is explained in more detail, along with the design considerations associated with them.

Embodiment

Embodiment in general doesn't necessarily require a physical body, but rather a "structural coupling" of a system to its environment [78]. This concept describes an embodiment in a situated sense, where an intelligent system is constantly interconnected and co-evolves with its environment. Following this theory, a social robot doesn't need to have a physical body, which is why virtual agents also belong to this category, although they only exist e.g. on a screen [20]. However, studies have shown, that having a physical, three dimensional robot can lead to a more appealing interaction for humans and an increased feeling of social presence, compared to a virtual agent [28]. A study by Kidd and Breazeal [34], examined the difference between the impression of a physically embodied robot and an animated character. Additionally they also included a televised robot next to the physically present one. While their findings support the positive effects of a robot with a physical body, they also discovered that these effects do not solely result from its physical presence. The televised robot was perceived as a real, physical thing as well, in contrast to the animated character which was perceived as fictional. Therefore similar positive effects can be expected, as long as the robot has a physical existence somewhere in the real world [34].

Morphology

When speaking of morphology, the external appearance of a robot is addressed. It can come in various forms and influences the social expectations people have towards robots. Similar to interacting with other humans, the way we interact with a robot is biased by its physical appearance. It is crucial that a robot's morphology aligns with it's functionality, in order to correctly match the user's expectations [20] [38]. Otherwise it can lead to unfulfilled user expectations and disappointment when a robot's appearance doesn't indicate what it can be used for. In the following a short insight into the classification by Fong et al. [20] is presented, which structured the appearance of social robots into four categories: *Anthropomorphic* (human-like), *zoomorphic* (animal-like), *caricatured* (cartoonish) and *functional* (indicating the robot's functionality).

In social robotics, a growing tendency towards the development of robots with anthropomorphic features can be observed. Anthropomorphism refers to the human tendency to assign human characteristics to non-human beings in order to better understand their actions [17]. Human-like interaction is the most natural way for people to engage, making it the most appealing form of interaction. The development of robots with human-like features uses this fact, to facilitate social interaction between humans and robots [79]. Therefore anthropomorphism doesn't only involve the robot's appearance, but also how the robot communicates and behaves. In terms of appearance, it is distinguished between *humanoid* and *android* robots. Humanoids still have a robotic look, while androids are designed as similar to humans as possible, using silicone skin, wigs, clothing and more human characteristics (Fig.2.3) [42]. However, in 1970 the Japanese roboticist Masahiro Mori made the assumption, that the likeability of a robot does not increase linearly with its level of human resemblance [44]. This phenomenon known as the *uncanny valley* effect (Fig.2.2), triggers negative reactions towards robots that closely resemble humans but lack complete human likeness [79].

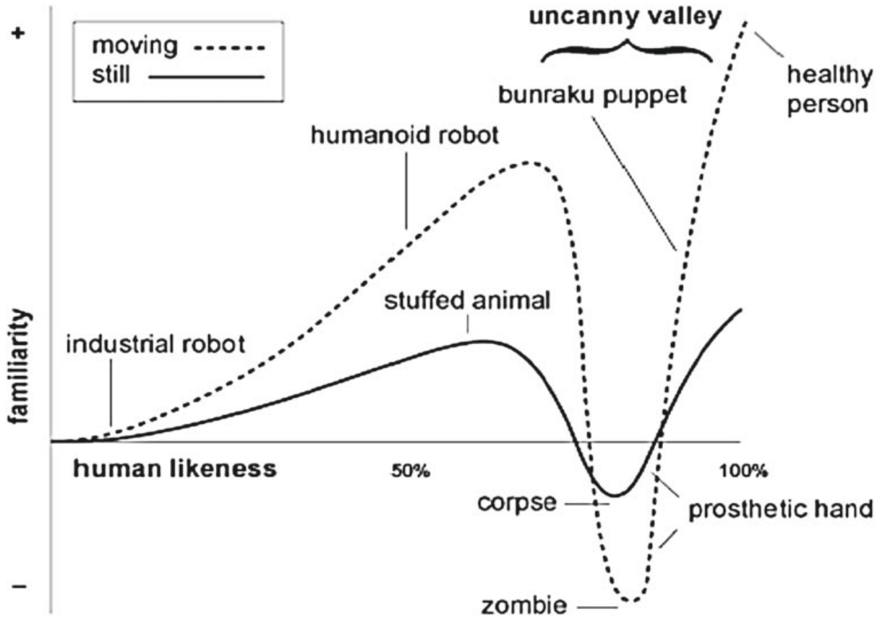

Figure 2.2: Mori's uncanny valley diagram. Reprinted from [72]

With a zoomorphic appearance, the uncanny valley effect is less likely to occur, since our standards for realistic depictions of animals are typically lower [20]. A zoomorphic appearance is often used for robots in the entertainment sector, where the robots serve as toys or companions resembling pets like cats and dogs (see AIBO Fig.2.1) [20]. But also in the health care sector zoomorphic robots can be found, because of their non threatening appearance [11]. Riba [45], a bear-like healthcare robot assistant, is displayed as an example in Figure 2.3.

A robot with a caricatured appearance is purposely designed with an distorted or unrealistic appearance, to lead the users' focus to specifically highlighted features. For example, the robot eMuu by Bartneck and Okada [6] uses its distinct facial features to display emotional expressions for giving intuitive feedback to the user (Fig.2.3).

Lastly, a robot with a functional appearance is designed purely based on it's functionality, without the use of decorative elements. This design approach is commonly used for service robots, to highlight the robots' task.

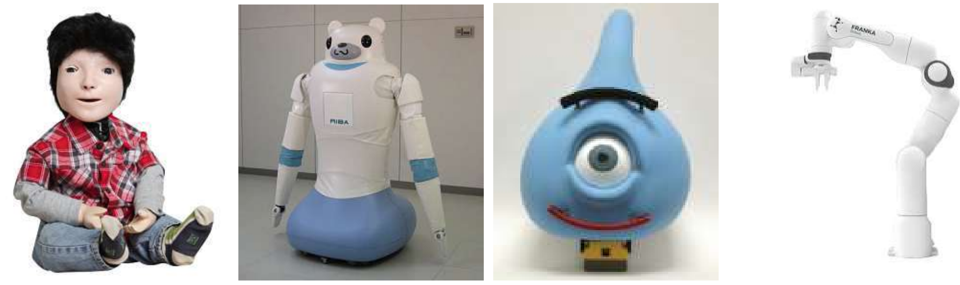

Figure 2.3: From left to rigth: Anthropomorphic robot *Kaspar*, zoomorphic robot *Riba*, caricatured robot *eMuu*, functional robot *Panda*. Reprinted from [45],[6] and [1]

Autonomy

Autonomy in a broad sense describes the extent to which a robot can function without the need for human assistance. It can vary from remote-controlled operations to entirely self-sufficient systems that independently sense, navigate, and engage with their surroundings [80]. As mentioned in the definitions above, according to Bartneck et al. a fully teleoperated robot cannot be defined as a social robot [4]. A more detailed definition was introduced by Beer et al. in 2014: "Autonomy is the extent to which a robot can sense the environment, plan based on that environment, and act upon that environment, with the intent of reaching some goal (either given to or created by the robot) without external control." (Beer & Fisk & Rogers, 2014, p.3, [8]). Based on this definition, the authors created a framework [8] to measure the level of robot autonomy (LORA), and further examine the impact of autonomy on HRI. It shows that the degree of autonomy can influence ratings of acceptance, trust, reliability and social interaction.

Assistive role

The assistive role describes the services offered by a robot, or in other words, its purpose. In the previous section, the research by Seifer et al. already mentioned robots that assist through physical contact and those whch assist through social interactions [19]. Another categorization in the context of elderly care are companion robots and service robots. A companion robot takes on the role of a sociable partner with the goal to improve the physical and mental well-being of its user [43]. Trough social interaction it tries to evoke emotional responses and further reduce stress and the feeling of isolation. In contrast, a service robot is more seen as an assistant, that takes on various tasks to enable its user to live independently. These can include helping with mobility issues, performing household chores and monitoring the health and safety of its user [43]. Besides elderly care, there exist various other application contexts and assistive tasks for social robots, which will be presented in the next section.

2.1.3 Applications of Social Robots

The application area of social robots is very broad and ranges from robots used for entertainment purposes to robots caring for patients in hospitals. The following sections give a short overview of different types of use cases, based on the categories of a systematic literature review of social robots introduced in [41] in 2022. The authors included a total of 344 robots in their analysis, all of which were either explicitly designed as social robots or utilized within the realm of social robotics. From this collection a total of 6 different use contexts was identified: service, entertainment, healthcare, education, research and telepresence. In the following graph (Fig.2.4) reprinted from [41], the total number of social robots in each application area within this review is illustrated. As this thesis focuses on face-to-face interactions between non-expert users and robots in an everyday environment, a closer look into robots used in service, entertainment, healthcare and education is presented. For better illustration, real-life examples of robots are given for each category. As most robots have been developed for more than one application area, some robot examples can be assigned to more than one category.

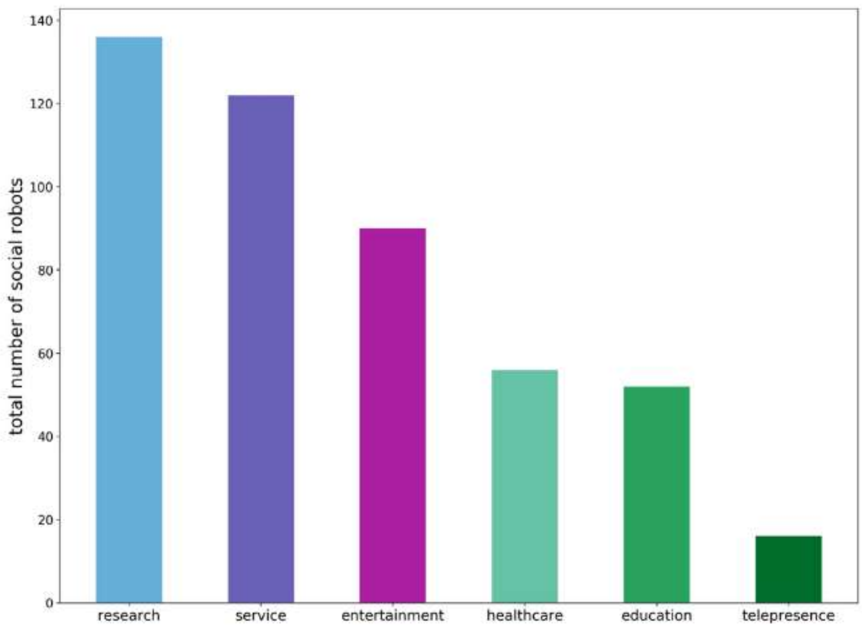

Figure 2.4: Total number of social robots in every application areas found in the 2022 review of [41]. Reprinted from [41]

Service

The service application field is very broad and includes public spaces as well as people's own homes. For private use, robots like Jibo [53] were developed as personal assistants in home environments, interacting with family members, reading emails and implementing other smart home features. In public areas, social robots are particularly used within the travel, tourism, hotel, and hospitality sectors. A key factor driving their high adoption in these industries is the engaging and interactive nature of social robots, which enhances customer experiences [69]. Robots perform roles such as receptionists, shopping assistants and museum guides, delivering accurate information to customers without getting tired of repetitive tasks. Two popular examples by SoftBank Robotics are Nao [61] and Pepper [62], which are used to inform, guide and welcome people at shopping malls, hotels and other institutions [69]. Also the robot used in this study, Sota [71] by Vstone Co., can be found in the service field doing front-desk tasks at hotels or giving presentations [46].

Entertainment

Social robots in the entertainment sector often include toy-like robots and robotic pets. A robot that fits both these descriptions is the robot dog AIBO by Sony [64], that was already commercially available back in 1999 (Fig.2.1). Like a real puppy, AIBO likes to be petted, learn tricks and grows every day as it learns from its users and living environment. Another popular example for animal-like robots is the robotic seal PARO by AIST [51], that is mostly used to reduce stress and increase the mental well-being of people with dementia. It imitates a baby seal by moving its head and makes sounds when being stroked. Therefore PARO is a representative for both entertainment- and healthcare context. Bioloid by ROBOTIS [58] is a robot toy which appearance can be customized by its user to be either humanoid or animal-like. As Bioloid is freely programmable it also fits in the education field. A further example of robots in the entertainment field is Vector [16], a small "robotic sidekick" originally created by Anki. Vector can be used for some usual companion robot tasks, like telling the weather, setting timers and answering questions of its user.

Healthcare

A couple of the robots that were previously mentioned are also represented in the healthcare sector. The robotic seal Paro is utilized in elderly care facilities by individuals who are suffering from dementia. Additionally, the dog robot AIBO has been explored as a rehabilitation tool in the same context. Studies have shown that both of these robots can significantly improve the interactive behaviour of their users as they increase their motivation to actively communicate [82] [66]. This applies to the communication between patient-and-robot, as well as patient-and-patient and patient-and-caregiver. However, the use cases for robots in elderly care don't end here. Social robots can further be used for supporting older people who want to remain independent in their own homes instead of moving to a care facility. In this context, a social robot can act as companion-type robot and improve its users quality of life by providing social interaction resulting in a decreased feeling of isolation. Moreover it can assist with other service-oriented tasks like health- and safety monitoring, setting reminders, or helping with household chores [33].

Another healthcare sector where robots are being tested and used is therapy for children with autism spectrum disorder (ASD). A popular approach in this context is the use of humanoid robots with distinct facial features, that make the robot capable of expressing simple human emotions. One of the robots in this field is Kaspar [68], a child-like android that is being used in schools, hospitals and personal homes as a social companion for children with ASD. Not only does Kaspar educate children about verbal interaction and nonverbal signals, but it also teaches them about appropriate physical touch [14]. A similar robot that already showed promising results in ASD therapy is Milo [57] [2]. This robot has a highly expressive face and comes in 4 versions that differentiate in skin color and displayed gender. However, even robots like Nao [61] without human-like facial features can achieve remarkable results in the field of ASD therapy and diagnosis [60]. Overall, it was observed that children with ASD show improved responses in various environments (school, home, etc.) with a robot present [56]. This tendency can be explained due to the repetitive, simple and non-judgemental nature of a robot. Furthermore, the presence of a robot with distinctive features like lights and sounds can captivate children's attention significantly [2].

Education

Three primary roles have been identified by the authors of [10] regarding the utilization of social robots in educational settings. First, a robot can serve as a tutor, supporting human teachers by educating users about certain topics. These teaching assistant robots (TARs), which have been researched and developed for a long time, often focus on various curricular domains for young children. Here, Nao [61] can be named as an example. Although Nao can be used as an educator in multiple fields, including disciplines such as STEM (science, technology, engineering, and mathematics) [52] and dancing [59], its usage in 2nd language learning will be highlighted in this thesis, as this particular scenario will resurface later on. When it comes to learning a second language, people can encounter challenges due to a late age of acquisition and irregular exposure to the language [49]. An advantage of using a social robot for language learning, is that the learners are provided with a (physical) agent that enables direct communication. Face-to-face communication is not only the most natural method for humans to interact, but having realistic conversations with a robot can be a good practice for using the language in real-life situations later on. In this scenario, interacting with a physical robot shows more advantages than using virtual agents, as users exhibit more engaging and socially interactive behaviors with a tangible, embodied system [10]. Additionally, in a classroom setting a robotic tutor could be used to complement the teacher's efforts, by offering additional lessons to support struggling students [30].

Second, a robot can take on the role of a peer for students. This approach tries to make the robot seem less intimidating by removing the hierarchical structures of a teacher-to-student interaction. Researchers in [76] conducted an experiment using a Nao robot, which assisted children in solving a puzzle, once in the role of a tutor and once as a peer. Their results showed that the children paid more attention to the peer-robot and achieved better result in completing the task compared to the tutor-robot.

In the third category, the roles are reversed as the robot becomes the novice and the user takes on the role of the educator. This approach follows the protégé effect, which describes the phenomenon where individuals learn more effectively when teaching someone else, compared to studying for themselves (learning-by-teaching) [13]. This theory finds support in [67], where a care-receiving robot (Nao) was introduced into English classes, resulting in improved vocabulary learning among 3- to 6-year-old Japanese children. Another robot application scenario within an educational context, involves users acquiring knowledge through the process of programming robot. One example for this approach is the previously mentioned educational robot-kid Bioloid [58], that can be freely built and programmed by its user. In this process, the users have to learn principles of engineering, mathematics and other sciences in order to successfully assemble the robot.

2.2 Cross Cultural Studies in HRI

Gaining user acceptance is a crucial step that determines the success of social robots. While a robot's characteristics (appearance, autonomy, behavior, ...) can influence its acceptability, research proposes cultural background as an additional critical factor, that might lead to different perceptions. Multiple studies suggest that robots are seen as social entities and are expected to follow the embedded social norms of their environment in both their verbal and non-verbal behaviors [35]. Therefore, an underlying assumption for cultural variations is that the social norms, which vary across different cultural contexts, lead to differences in the perception of robots. If these social rules are not taken into account, users might perceive and react to robots in ways that differ from the robot's original intention [38]. Consequently, there is no one-fits-all design guideline for social robots that ensures their successful introduction in different cultures. To better understand these culture related preferences, cross cultural studies come into play. They view robots as embedded within specific cultural contexts and seek to identify differences in perception and acceptance. With these insights they further aim to develop culturally adaptive robots. Frequent comparisons are made between Eastern and Western (American and European) cultures, as there exist distinct differences in cultural attitudes, technological adoption and social norms between these regions. However, it is not uncommon to come across contradictory results, which highlights the need for more in-depth research in this area. In the following an overview of cultural differences in HRI is presented, focusing especially on variations between Eastern and Western countries.

2.2.1 Communication style

One field where cultural differences arise is communication style, as its significantly influenced by the cultural context we live in [54]. While low-context cultures show an expressive and direct way of communication, people in high-context cultures express themselves more implicitly [38]. A study bei Rau et al. [54] analyzed if people preferred robots which reflected their own culture's style of communication. They conducted an experiment with Chinese and German participants, which included solving a task commented by a robot giving advice either implicitly or explicitly. Their hypothesis was partially proven, as the German participants perceived the explicit robot as more likable, trustworthy and credible, and were more likely to take its advice, compared to the implicit one. However, there was no significant difference between implicit and explicit communication style found among the Chinese participants. In a subsequent study [73] including participants from the US and China, the Chinese participants were more influenced by the robot when it used implicit communication, and the US participants responded more to the explicit robot.

2.2.2 Appearance

In terms of appearance, varying preferences between cultures were observed, as the question whether a robot should look more machine-like or human-like brought up contradictory results. In a study by Bartneck et al. [3], which included images of functional and anthropomorphic robots, Japanese participants showed a preference for conventional robot designs, whereas US participants favored androids. These results could be recreated by another study [29], where Japanese participants favored robots with less anthropomorphic features. In contrast to these findings, in a study by Haring et al. [22] Japanese participants expressed more acceptance towards human-like robots.

2.2.3 Application context

Regarding application context, the question whether robots should take on social roles or rather stay in industrial settings, appears. Looking at western cultures, there seems to be a rather negative attitude towards the deployment of social robots as studies like [37] show. In contrast to Turkish and Korean participants, US participants exhibited a lower level of acceptance towards social robots. They did not see a need for robots as companions or sources of entertainment, primarily viewing them as functional tools. Additionally, they showed preferences for machine-like robots without facial features or expressions. Both Korean and Turkish participants were more positive towards having robots in their daily environment, primarily envisioning them assisting mothers with household tasks. In another study by Nitto et al. [47], the attitude of Japanese, German and US participants towards the use of robots in various applications was compared. In Japan and Germany, the majority of respondents expressed interest in using robots for office tasks like managing schedules and assisting with clerical work. However, in terms of using robots for personal tasks such as managing schedules, setting alarms or making phone calls, interest was lower in Germany compared to Japan and the US. Across all three nations, the intention to use robots in education and medical services was generally low. Another study by Takayama et al. [65] discovered that people prefer robots for tasks that involve service orientation, and humans for roles that require creativity and social skills. These findings are consistent with the conclusions of Dautenhahn et al. [15], who observed that people exhibit greater comfort with robots handling household chores compared to social tasks such as childcare.

2.3 Robots in Japan

2.3.1 The Robot Kingdom?

It is undeniable that Japan is a pioneer in the field of robotics, particularly in the research and development of social robots. After all, in the 1980s it was already referred to as the "Robot Kingdom", signifying its global dominance in industrial robotics as well as its perceived willingness to accept robots as companions and partners [81]. Until today Japan has held it's reputation as a land where people are "loving the machine" [25]. There are two widely discussed theories that try to explain this positive image of robots in Japan through cultural factors: Religion and media representation.

Religion

As Buddhism and Shintoism are the primary religions in Japan, their practices are deeply grounded in the Japanese history and culture. In both Buddhist and Shintoist beliefs, the concept of animism holds significant importance. Animism describes the belief that all living beings and inanimate objects possess a soul, enabling them to subjectively experience the world [81]. Takanishi Atsuo, a professor at Waseda University, links this concept to robots as follows:

> "We cannot treat robots and other artifacts less worthily (rudely/roughly/impolitely) or even too-worthily (too-goodly/too-muchly) because we are no more than they are and even some of them become a god... [This] makes the society to be highly ecological and highly friendly to anything, including artificial ones." (Takanishi, 2007, cited in Šabanović, 2020, p.26, [81])

Another crucial term that shapes the Japanese culture is *kokoro*. Although there exists no exact translation, *kokoro* can be understood as the spirit, heart or mind and is considered a fundamental characteristic of humanity [31]. The notion of *kokoro* also flows into the design and development of robots, as Japanese roboticists seek to create "machine's with a heart" [23]. Due to these cultural and philosophical leanings, researchers suggest that these might lead to greater openness among Japanese people towards accepting robots as social agents that coexist alongside humans, or even as companions [39].

Media Representation

Given the varied portrayal of robots by the media across cultures, scientists assume that the positive portrayal of robots in the Japanese media influences attitudes towards them. Unlike the common Western narrative of "robots taking over the world," popular Japanese Manga movies focus on other themes. In anime and manga, robots are frequently portrayed as human partners that are kind and friendly (e.g. Doraemon – Gadget Cat from the Future) or fight for justice (e.g. Astro Boy) [39] (Fig.2.5). These fictional robots typically have a human or animal-like form and coexist with humans in daily life

[47]. Though the pattern of "good against evil" is also present in Japanese fiction, the difference is that humans are not automatically portrayed as good and robots as evil. Instead, characters can play either good or evil roles, regardless of whether they are human or robot [5].

Figure 2.5: Astro Boy and Doraemon. Reprinted from [37]

Naturally, one might wonder why the Japanese media is so supportive of robots in the first place. It is suggested, that the political and industrial motivations of the Japanese government are mirrored in the favorable depictions of robots within the media. With societal issues arising from an aging population and declining birth rates, the development and implementation of social robots is seen as a possible solution and therefore strongly encouraged [39].

2.3.2 Robot's (Won't) Save Japan

Contrary to Japan's reputation of being a robot-loving society, there are cross-cultural studies that challenge this positive image of Japans relation to robots. In 2006 a study by Bartneck et al. [7] compared attitudes towards robots between Japan, Mexico and the US and showed contradicting results to the Japanese stereotyt. The Japanese participants showed significant concerns about the societal impact of robots, especially regarding the emotional implications of interacting with them. Surprisingly, the US participants showed the least negative attitudes towards interacting with robots. Another study [40] also found no support for the hypothesis that Japanese people have a stronger preference for robots and feel warmer towards them compared to people in the US. These findings possibly stem from the fact, that as a culture with a long robot-related history, the Japanese have more robot-related experiences. Therefore, they could be more aware of a robot's capabilities and especially limitations, compared to other cultures [7].

Similar to these findings, the results of 18 months of ethnographic field work between 2016 and 2020 by the researcher James Wright show the reality of Japan's care robots. In his book "Robot's won't save Japan" [75], Wright challenges the hype around care robots and points out the existing issues these robots face in real life environments: Robot's designed to lift people up can become obstructive themselves due to their bulky design, creating an additional obstacle for the care staff. But also smaller robots like Paro can bring some difficulties: Care staff reported that in some cases, an elderly person could become overly attached to the robot, or exhibit problematic behavior (trying to peel of the robots fur) when interacting with it, which required extra attention from the staff instead of easing their work load. Similarly, robots that are used for physical exercise like Pepper often needed the staff to participate in the training in order to motivate elderly participants to follow the robot's lead.

These findings give a look into the reality of social robot's in Japan. Although there are examples of social robots being used in various everyday sectors like health- and elderly-care, or serving as assistants and guides [39], there is still a long way to go to achieve their successful deployment. Or, as Wright put's it:

> "Accepting the idea of robots is one thing; being willing to interact with them in real life is quite another. What's more, their real-life abilities trail far behind the expectations shaped by their hyped-up image. It's something of an inconvenient truth for the robot enthusiasts that despite the publicity, government support, and subsidies—and the real technological achievements of engineers and programmers—robots don't really feature in any major aspect of most people's daily lives in Japan, including elder care." (Wright, 2023, p.1, [74])

2.4 Robots in Austria

2.4.1 What do we know?

While there is a substantial amount of robot-related literature available for Japan, research focusing on the situation in Austrian is more limited. However, studies like the Eurobarometer 87.1 survey conducted in 2017 [18], suggest a critical view of robots from Austrian citizens. In [21], the focus was placed in particular on the German and Austrian results of the Eurobarometer survey. As seen in the left part of Fig. 2.6, the authors presented the average ratings of attitudes toward autonomous robotic systems across European countries, using a z-standardized scale centered at 0. The graph highlights the Austrian results, which showed a rather skeptical attitude towards autonomous robotic systems, with ratings falling below the average of the other 27 participating EU countries. On the right side in Fig.2.6, the percentage of Europeans having had previous experiences with robots in private or public spaces are illustrated. 20% of Austrian participants reported the past or current usage of a robot in their home, workplace, or other settings, exceeding the EU average. As anticipated by Gnambs, attitudes towards robots were systematically linked to respondents' prior experiences with them. Individuals who had previously used a robot were significantly more positive compared to those without any prior experience [21]. According to the International Federation of Robotics (IFR)[26], Austria's manufacturing industry had a robot density of 219 robots per 10,000 employees in 2022. These results lie above the European- (136), American- (120) and Asian average (168). Most of the industrial robots in Austria are used in the automotive sector [21].

In contrast to industrial robots, statistics on service or social robots in Austria could not be found. As a result, it becomes necessary to examine research from other Western and

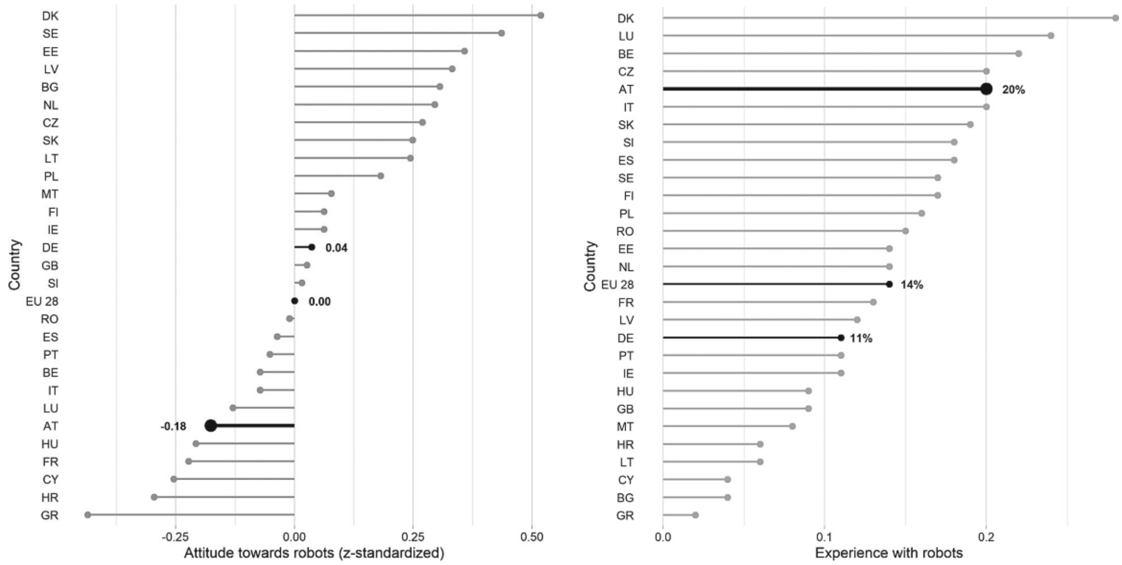

Figure 2.6: Attitudes towards robots and percentage of European respondents reporting experiences with robots. Reprinted from [21]

European countries to gain a better understanding. Western media, for example, portrays robot personalities in a more mixed fashion compared to Japan, with both friendly robots (e.g., Wall-E) and evil robots (e.g., Terminator) being common [39], along with the typical "Robots will take over the world" narrative [22]. Since Germany shares many similarities with Austria due to its language, proximity, and history, it is also interesting to look at the previously mentioned study by Nitto et al. [47] in more detail: While German participants found some interest in using robots in office assistance, guidance at stores and hotel services, they also showed significant reservation, especially in personal or sensitive contexts like nursing care, medical services and education. Another interesting finding was that 73% of the 1,382 German participants reported never having used a robot, and 85% indicating they had never interacted with a social robot. The results in Japan were highly similar, with 72% of participants having never used a robot and 86% never having used a social robot. However, when asked about the prospect of adopting robots into their daily lives, 20% of German respondents said they would feel very comfortable, and 43% somewhat comfortable. In Japan, the responses were again similar, with 24% feeling very comfortable and 46% somewhat comfortable with this idea. These high resemblances in the results between Japan and Germany indicate a similar stance towards robots. To confirm if Austria might exhibit similar patterns, more specific research on Austrian attitudes towards robots is needed.

CHAPTER 3

Research Framework and Hypotheses

3.1 Research Framework

The goal of this thesis work is to gain more clarity into the open questions and contradictions of previous cross-cultural studies in HRI. As stated in 2.1, there are multiple factors influencing people's responses to robots. In this thesis I want to closely examine two of them: Cultural context and task context. Drawing from the existing findings stated in section 2.2, a cross cultural study between Austria and Japan will be conducted, including the same social robot in four different roles: A companion for the elderly (EC), a hotel receptionist (HT), a waiter (WT) and a tutor robot (TU). These roles were selected because of the following reasons: First, they all display use cases that are similar to previous HRI studies [9] [32] [33] and are to some extent already present in real life contexts [50][77]. This is very essential as the participants should be able to relate to the scenarios as much as possible in order to achieve accurate results. Secondly, the scenarios cover a wide age range of users, including a 7 years old child, two adults in their 20s/30s and an elderly person around their 60s/early 70s. This diversity in age is important, to find out whether the age of the target users has an influence on the participant's attitude towards the robot. Lastly, it was purposely chosen to include two scenarios portraying higher sociable interactions with vulnerable groups (elderly care and child tutoring), alongside two scenarios focusing on service-oriented public tasks (hotel and restaurant). Tutoring and elderly care are classified as higher sociability tasks because they involve more extended and personal interactions compared to the repetitive nature of waiter and receptionist tasks. This addition aims to uncover potential differences, aligning with previous research that has highlighted a general preference for robots in service-oriented roles [65] [15] [55].

3.2 Hypotheses

The following hypotheses were formulated to examine open questions concerning the main effect of culture and robot task in human-robot interaction.

H1. Task Over Culture: The robot's task will have a greater impact on participants' perception and attitude towards the robot than their cultural background.

H2. Service Tasks Over Social Tasks: Both Austrian and Japanese participants will prefer a robot carrying out a general service task (waiter, receptionist) versus a higher sociability task including a vulnerable user (child, elderly person).

CHAPTER 4

Methodology

4.1 Design and Participants

To test the hypothesis, a 2×4 study was designed using cultural context (Austrian and Japanese) as a between-subject factor and application context (tutoring, elderly care, waiter, and receptionist) as a within-subject factor. Each participant watched all four robot-scenarios and answered the same set of questions after each video. To prevent sequence bias, the order of the scenarios was randomized for each participant. All written materials, instructions, and robot speech were provided in Japanese for Japanese participants and in German for Austrian participants. The text was initially composed in English and subsequently translated into German and Japanese by native speakers to ensure accuracy and natural phrasing. The standardized scales included in the study were translated in the same manner, as official translations into German or Japanese were not available. A translation of GAToRS and RoSAS into Japanese and German can be found in the 7. The online survey was send out to technical students in Austria and Japan using the platform *socisurvey*. It was structured into the following sections: Introduction, demographics, general attitude towards robots, the four robot scenarios and post-questionnaire.

The survey was primarily distributed through word of mouth and student platforms at the TU Wien and the Osaka Institute of Technology. Consequently, it is likely that most participants are students from these two universities, though there may also be representation from others. A total of 70 participants responded, but those who met the target group's criteria (age, field of study and cultural background) were prioritized. Also preference was expressed for students who had lived in Japan or Austria for at least ten years. This resulted in 30 Japanese and 31 Austrian participants being selected. The gender distribution for both cultures was about one third female (12 for Japan, 11 for Austria) and two thirds male (18 for Japan, 20 for Austria). In terms of age, the average of the Austrian students was higher (27) compared to the Japanese (22). Most

		Austria (n=31)	Japan (n=30)
Average age [M(sd)]		27 (2.97)	22 (1.35)
Gender	Male (n)	20	18
	Female (n)	11	12
	Other (n)	0	0
Highest Degree	Highschool (n)	7	11
	Bachelor (n)	15	16
	Master (n)	6	3
	Doktor (n)	3	0

Table 4.1: Demographic information on participants.

participants from both countries indicated that a Bachelor's degree was their highest level of education, with all participants having at least completed high school. While students of various technical fields participated, most of them came from a Computer Science background (16 Japan, 17 Austria). Please refer to table 4.1 for more data.

4.2 Survey structure

4.2.1 Introduction

When opening the survey link the participants first had to choose between the German and Japanese language version. They were then presented with a brief introductory text explaining the study's objective, the estimated duration (15 minutes), and the necessary tools (a tablet or laptop with functional audio). The participants were advised to use a tablet/desktop device to view the videos in an appropriate size. They were informed that participation was voluntary, and that the data provided will be used anonymously for research purposes and the further publication of this diploma thesis.

4.2.2 Participant Demographics

The participants were asked to state their nationality, gender, age, field of study, highest education and previous experiences with robots. In addition to choosing their nationality (Austria, Japan, Other), participants were also asked whether they had lived in their selected country for more than 10 years. For measuring the previous experiences with robots, participants stated what kind of interaction they had (if any) and in which context.

4.2.3 General Attitude towards Robots

To measure the general attitude towards robots the standardized *General Attitude Towards Robots Scale* (GAToRS) [36] by Koverola et al. was used. This scale was chosen because, unlike other conventional scales such as NARS that focus solely on negative aspects, GATORS evaluates people's attitudes towards robots by equally considering both positive and negative perspectives. Moreover, the scale distinguishes between attitude on a personal and societal level, resulting in four attitude factors: Personal level positive (P+), personal level negative (P-), societal level positive (S+) and societal level negative (S-). A 7-point Likert scale (1 = strongly disagree, 7 =strongly agree) was used with an additional option "can't assess".

4.2.4 One Robot, four Roles

To investigate the influence of application context in HRI, participants were shown four videos of the same robot performing different roles: Tutor, receptionist, waiter and companion for elderly people. These roles were presented in a randomized order. To realistically portrait these roles, a SOTA robot [71] was chosen (Fig.4.1). SOTA is a social conversational robot, created for holding presentations, front-desk tasks, exhibitions or usage at home. It was selected because of it's social design and functionality, which align well with the roles tested in the study. In every video a dialogue between the SOTA robot and a human user was shown. The video was filmed from the first person point of view (the user's perspective), therefore the user was mostly represented by voice and only two times a hand was shown as the task required it (paying by card, showing an ID). To make sure this perspective was not confusing for the participants, a separate video pretest was conducted prior to this survey. The duration of the videos was approximately 70 seconds, with the Japanese versions being slightly longer due to linguistic differences.

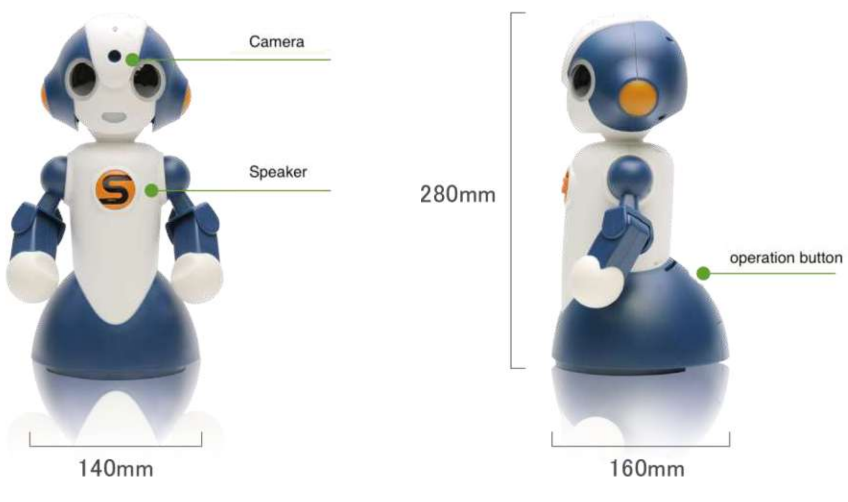

Figure 4.1: SOTA product specifications. Reprinted from [70]

Filming and editing

For making the videos the Sota Robot was programmed and filmed in front of a green screen (see Fig.4.2). Depending on the application scenario, an appropriate background image was generated using the Adobe Photoshop AI generative tool and inserted in the video with Adobe Premiere. In all four scenarios the setup was maintained consistently: The robot was placed in a central position on a table with a small object next to it to provide a clear reference for the robot's size. Only the human-user's voice varied across scenarios, with an elderly person for the companion robot task, a child for the tutoring task and an approximately 20–39 year old user for both reception and waiter scenarios. The dialogues were consistently structured across all scenarios, with the robot both initiating and ending the conversation. A script of the exact dialogues is provided in the 7. For enhanced readability an English translation was added next to the Japanese and German text. While watching the video, subtitles could be activated to ensure every participant was able to follow the content of the dialogue 4.3.

Figure 4.2: From top left to bottom right: Robot as a receptionist, waiter, tutor and companion for elderly people.

Figure 4.3: Receptionist robot video with subtitles.

Dialogue and Voice

For both the German and Japanese videos the same dialogue between user and robot was recorded, only differing in the spoken language, “hello/goodbye”-gestures, gesture timing and the voices used for the robot and users. As it is a common habit in the Japanese culture to bow while greeting or expressing gratitude [48], a bowing movement was added for the Japanese version of the scenarios. For the other gestures there was no need for any modifications besides adjusting their timing. This adjustment was necessary, as the change of language required some minor changes in timing for synchronizing the non-verbal signs with the verbal content. It is also due to the same reason that the Japanese videos were on average about ten seconds longer than the German ones. The voices used for both the robot as well as the three different types of users (child, adult and elderly) were generated using an online text to speech engine, as it was not feasible to find real voice actors for both languages in time. While this has no major impact on the robot’s voice, it cannot be excluded that the user’s voice was perceived as more artificial by the participants compared to a live recording. However, making this trade-off was necessary to ensure that the user’s voices matched their intended age and culture. Furthermore, it has to be noted that voices fluently speaking both Japanese and German at a native level were not available. As a result, different voices for both the robot and the users had to be used for the Japanese and German versions. Despite this divergence, all the voices employed for Japanese and German maintained similar attributes in terms of speed, pitch, gender and age, to keep a difference in the participants’ experience as minimal as possible. Related to the same cause, the user voices for all scenarios are exclusively female. This decision was based on a higher similarity found in the available female voices between both languages.

Questions

After watching each video, the participants answered the following seven questions on a 7-point Likert type scale:

- PU1: I find the robot useful in this context.
- PU2: It would be practical to have the robot in this context.
- PU3: I think the robot can help with many things in this context.
- ATT1: I think the robot would make the lives of its users more interesting.
- ATT2: It is good if the robot is used in this context.
- ATT3: I would like to interact with the robot myself.
- FAM: I would like my parents (or other close relatives) to interact with the robot.

The questions were derived from the perceived usefulness (PU1 - PU3.) and attitude towards technology (ATT1 - ATT3) sections of the Almere model [24] and adapted to fit the context of this study. Additionally, a seventh question was added (FAM) to capture any feelings of comfort or discomfort when thinking about close family members using the robot.

4.2.5 Post-questionnaire

The last section contained the *Robotic Social Attributes Scale* (RoSAS) [12] to measure the participant's general perception of the SOTA robot. With 18 items measuring the dimensions of Warmth, Competence and Discomfort, this scale is used to determine the social perception of robots. The 18 items were measured on a 7-point Likert scale. Since the robot exhibited consistent behavior and personality traits across all four scenarios, it was deemed sufficient to have participants rate their overall perception of the robot after viewing all of the videos.

To create an additional comparison between the four robot scenarios the participants were asked to identify their most and least favorite role for the robot (if any) and to explain their reasoning. Additionally, they were provided with a space to share any further remarks about the study at the end.

CHAPTER 5

Findings

5.1 Experience with and Attitude towards Robots

5.1.1 Prior Encounters

To understand people's perceptions of robots, it is crucial to determine whether and how they have previously encountered them. With only one Austrian participant having no prior experience with robots at all, almost every participant stated to have encountered robots in some way. The results revealed distinct differences in robot-related experiences between Japanese (JP) and Austrian (AT) participants (see Fig. 5.1 and Table 5.1).

Previous experiences with robots		**Austria (n= 31)**	**Japan (n=30)**
Experience	I have no experience with robots	1	0
	I have seen robots	6	14
	I have interacted with robots	15	13
	I have worked with robots	7	0
	I have built robots	2	3
Context	Work / University	26	21
	Museum	13	9
	Restaurant	10	24
	Store	5	14
	Hotel	3	8
	Home	8	2
	Elderly home	0	1
	Other	2	1

Table 5.1: Previous experiences with robots of Austrian and Japanese participants.

Among the Japanese participants, 14 out of 30 reported to have seen robots before, making it the most common form of exposure. Interestingly, only 6 out of 31 Austrians indicated the same. However, interaction with robots was reported by a similar number of participants in both countries (Japanese, 15 Austrians). Regarding more direct forms of interaction with robots, like working with them, the results diverge. Zero of the Japanese participants indicated to have worked with robots before, whereas 7 Austrian participants reported having done so. Additionally, the experience of building robots was relatively rare, with 3 Japanese and 2 Austrians reporting this activity.

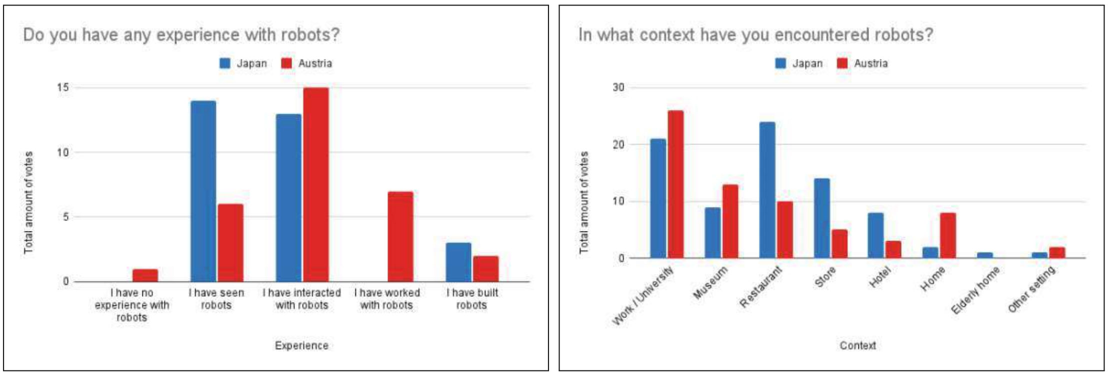

Figure 5.1: Previous experiences with robots of Austrian and Japanese participants.

These findings highlight the varying degrees of familiarity with robots in the two countries, with Austrians showing a broader range of direct interaction, particularly in professional settings. In general, the percentage of subjects who previously came in contact with robots in both countries is very high. However, it is possible that this trend stems from the participant's technical background, which gives them more opportunities to get in contact with robots in an university or work environment. To further investigate this matter, the participants were also asked in which context they had made their previous encounters with robots. Participants could select multiple contexts from a predefined list (work/university, museum, restaurant, store, hotel, home, elderly home) or specify another setting where they had encountered robots (see Fig.5.1).

The data confirms that the most frequent setting for robot encounters among Austrian participants was at work or university, with 26 Austrian participants selecting this option. Although 21 Japanese participants also reported encountering robots in this context, the predominant setting among Japanese was restaurants, with 24 respondents choosing this option. In contrast, only 10 Austrian participants noted encounters with robots in restaurants. Encounters in museums were slightly higher among Austrians (13) than Japanese (9). In both retail as well as hotel settings, Japanese participants reported more encounters (14 retail, 8 hotel) than Austrians (5 retail, 3 hotel). This could indicate a more widespread use of social robots in these service tasks across Japan. The least selected options were elderly homes, with only 1 Japanese participant, and other settings (1 Japan, 2 Austria).

The findings suggest that while students from both countries frequently encounter robots in professional or educational environments, their experiences in commercial service sectors like restaurants or stores, vary significantly. This reflects possible differences in the integration of robots into daily life in Japan and Austria.

5.1.2 Attitude

To assess participants' attitudes towards robots, they were required to complete the General Attitudes Towards Robots Scale (GAToRS) [36] prior to viewing the robot videos. This scale measures "participants' comfort and enjoyment around robots (P+), unease and anxiety around robots (P), rational hopes about robots in general (S+), and rational worries about robots in general (S-)" (Koverola, 2022, p.1561, [36]). For analyzing the results, the following approach was used:

1. **Overview:** To get a first overview of the data, the mean, median and standard-deviation were calculated for each item (Table 5.2). The mean values are illustrated in Figure 5.2, highlighting the significant differences that were found. In the following, Japanese mean values will be abbreviated with J and Austrian with A, for an increased readability.

2. **Analysis at item- level:** To explore potential cultural differences between Japanese and Austrian participants, a Mann-Whitney U test was applied to each of the 20 GATORS-items individually. This non-parametric test was suitable for comparing differences between Austria and Japan, as the data was not parametric.

3. **Analysis at subscale-level:** After analyzing differences at an item-level, the mean response for each participant across the four subscales of the GATORS questionnaire (P+, P-, S+, S-) was computed. Afterwards, another Mann-Whitney U test was applied for each of the four subscales, to identify any statistically significant differences between the Austrian and Japanese groups at a subscale-level. The goal was to understand whether the overall patterns of responses on each subscale differ significantly between the two cultural groups.

4. **Cronbach Alpha:** To test the internal consistency of the GAToRS questionnaire, Cronbach's Alpha was used to assess how well the items within each subscale correlated. While the subscales P- (AT: 0.66, JP:0.72) and S+ (AT: 0.75, JP:0.82) showed acceptable internal consistency, indicated by higher Alpha values, the subscales P+ (AT: 0.51, JP:0.54) and S- (AT: 0.62, JP:0.52) had lower Alpha values. Not meeting the threshold of 0.7 suggests that responses for P+ and S- were less homogeneous, potentially affecting their reliability in consistently measuring the intended constructs. Nevertheless, the subscales were still calculated, acknowledging the variability in the data while maintaining consistency in the analysis, despite the lower internal consistency for certain subscales.

This approach allowed a detailed exploration of cultural differences both at an item-level and across broader subscales, offering a comprehensive view of how responses vary between different cultural contexts.

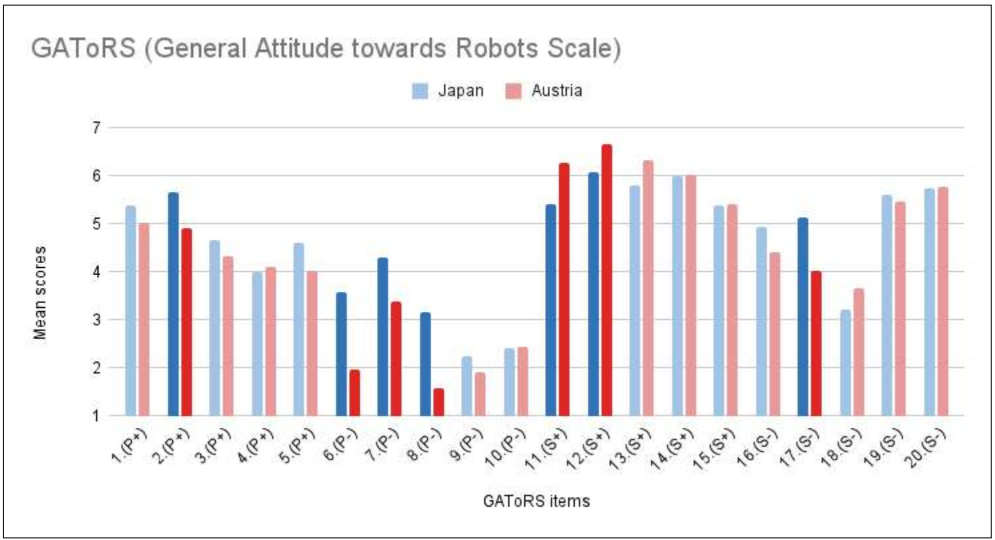

Figure 5.2: Mean values of GAToRS. Highlighted bars indicate a statistically significant difference. Scores on a Likert scale from 1 (strongly disagree) to 7 (strongly agree). P+ = Positive personal, P- = Negative personal, S+ = Positive societal, S- = Negative societal

P+

Austrian and Japanese participants exhibited similar positive attitudes towards robots on a personal level. For instance, both groups showed neutral to slightly positive agreement with items 3 (“I can trust a robot”, A = 4.33, J = 4.67), 4 (“I would feel relaxed talking with a robot”, A = 4.09, J = 4.00) and 5 (“If robots had emotions, I would be able to befriend them”, A = 4.03, J = 4.59). Item 1 (“I can trust persons and organizations related to development of robots”) received a slightly higher agreement of 5.03 in Austria and 5.37 in Japan.

The only item showing a significant difference with a p-value of 0.03239 was item 2, indicating that Japanese participants hold a significant stronger belief that “persons and organizations related to development of robots will consider the needs, thoughts and feelings of their users” (J = 5.66). However, also the Austrian participants seemed to agree with this statement (A = 4.29).

With only one item in P+ being statistically significant, there was no significant difference found when conducting a Mann-Whitney U test over the whole P+ scale (p = 0.067041). This indicates that the personal positive attitudes towards robots are similar in Japan and Austria.

P-

For the negative personal attitudes, no significant difference was found for items 9 ("I would feel very nervous just being around a robot", A = 1.90, J = 2.23) and 10 ("I don't want a robot to touch me", A = 2.45, J = 2.40). The low mean and median scores suggest that both countries disagreed with these two statements.

However, cultural differences could be observed for the other three items. For item 6 ("I would feel uneasy if I were given a job where I had to use robots", A = 1.97, J = 3.57), the difference in mean scores between Austrian and Japanese participants was highly significant, with a very low p-value of 0.000002. A similarly strong difference was observed for item 8 ("Robots scare me", A = 1.58, J = 3.17), with a p-value of 0.000014, highlighting the difference between Austrian and Japanese perspectives. Another significant difference (p = 0.011926) was found for item 7 ("I fear that a robot would not understand my commands", A = 3.39, J = 4.31).

With three items in the P- subscale showing significant differences, it is not surprising that a significant difference was also found on a subscale-level. The low p-value of 0.00044 not only indicates a significant result but also highlights that the consistently higher mean scores of Japanese participants reflect a higher negative personal attitude compared to Austrians.

S+

On a societal level, participants from both Austria and Japan strongly agreed on item 13 ("Assigning routine tasks to robots lets people do more meaningful tasks", A = 6.32, J = 5.80), item 14 ("Dangerous tasks should primarily be given to robots", A = 6.03, J = 6.00) and item 15 ("Robots may make us even lazier", A = 5.42, J = 5.38).

For the remaining two items in this subscale, the following significant differences were observed: For item 11 ("Robots are necessary because they can do jobs that are too hard or dangerous for people", A = 6.26, J = 5.40), a p-value of 0.00769 indicated a significant difference between Austrian and Japanese participants. Similarly, item 12 ("Robots can make life easier", A = 6.65, J = 6.07) also showed a significant difference (p = 0.01527), as the Austrian mean score was higher than the Japanese.

Although only two items were found to show significant cultural differences, the Mann-Whitney U test for this subscale turned out to be statistically significant as well (p = 0.04855), indicating a slightly higher positive attitude at a societal level for Austrian participants.

S-

In terms of societal concerns, most items showed no significant differences between cultures. However, the following varying results between items were observed: Items 19 ("Robotics is one of the areas of technology that needs to be closely monitored", A = 5.45 , J = 5.59) and 20 ("Unregulated use of robotics can lead to societal upheavals", A = 5.45 , J = 5.59) scored high mean and median values around 6 in both countries. Participants also displayed neutral to slight agreement with item 16 (“Robots may make us even lazier”, A = 4.42, J = 4.93). In contrast, item 16 (“I am afraid that robots will encourage less interaction between humans”, A = 3.65, B = 3.21) received lower scores in Austria and Japan.

The only item that exhibited a significant variance between cultures (p = 0.01161) was item 17 (“Widespread use of robots is going to take away jobs from people”, A = 4.03, J = 5.14). This reflects a bigger concern about this issue among Japanese participants.

Since only one item showed a significant cultural difference, the subscale-level result also revealed no significant difference between the two cultures (p = 0.238635).

GAToRS		Austria			Japan		
		M	Md	SD	M	Md	SD
P+	1. I can trust persons and organizations related to development of robots.	5.03	5	1.285	5.37	6	0.999
	2. Persons and organizations related to development of robots will consider the needs, thoughts and feelings of their users.	4.92	5	1.383	5.66	6	1.078
	3. I can trust a robot.	4.33	4	1.028	4.67	5	1.373
	4. I would feel relaxed talking with a robot.	4.09	4	1.423	4.00	4	1.491
	5. If robots had emotions, I would be able to befriend them.	4.03	4	1.884	4.59	5	1.824
P-	6. I would feel uneasy if I was given a job where I had to use robots.	1.97	2	1.224	3.57	3	1.406
	7. I fear that a robot would not understand my commands.	3.39	3	1.520	4.31	5	1.449
	8. Robots scare me.	1.58	1	0.848	3.17	3	1.555
	9. I would feel very nervous just being around a robot.	1.9	2	1.044	2.23	2	1.381
	10. I don't want a robot to touch me.	2.45	2	1.710	2.40	2	1.522
S+	11. Robots are necessary because they can do jobs that are too hard or too dangerous for people.	6.26	7	0.998	5.40	6	1.522
	12. Robots can make life easier.	6.65	7	0.661	6.07	6	1.143
	13. Assigning routine tasks to robots lets people do more meaningful tasks.	6.32	7	0.909	5.80	6	1.297
	14. Dangerous tasks should primarily be given to robots.	6.03	6	0.983	6.00	6	1.547
	15. Robots are a good thing for society, because they help people.	5.42	6	1.205	5.38	5	1.776
S-	16. Robots may make us even lazier.	4.42	5	1.649	4.93	5	1.893
	17. Widespread use of robots is going to take away jobs from people.	4.03	4	1.683	5.14	5	1.580
	18. I am afraid that robots will encourage less interaction between humans.	3.65	3	1.780	3.21	3	1.760
	19. Robotics is one of the areas of technology that needs to be closely monitored.	5.45	6	1.287	5.59	6	1.402
	20. Unregulated use of robotics can lead to societal upheavals.	5.77	6	1.547	5.77	6	1.484

Table 5.2: Mean (M), median (Md) and standard deviation (SD) of GAToRS. Highlighted rows indicate a statistically significant difference ($p < 0.05$). Scores on a Likert scale from 1 (strongly disagree) to 7 (strongly agree). P+ = Positive personal, P- = Negative personal, S+ = Positive societal, S- = Negative societal.

5.2 Robots Scenarios - Differences Within and Between Cultures

After watching each robot scenario, the participants had to answer six questions derived from the Almere model [24] and one additional question for capturing attitudes towards family members using the robot (see section Methodology 4.2.4 for more info). As the results of this section are critical for testing our hypotheses, the evaluation was conducted in two steps:

1. **Within cultures:** The following steps were done for Austria and Japan separately: To get a first overview of the data, the mean, median and standard deviation for each question were calculated (Table 5.5). Then the mean scores of each question were visualized in a graph (Fig.5.3, Fig.5.4) and compared between the scenarios, to test H2 (Service Tasks Over Social Tasks) and find out any variations between the four scenarios. To examine whether there were overall significant differences, a Friedman test was conducted for each Almere question. This testing method was chosen because the collected data was non-parametric, and there were repeated measures, meaning the same participants rated the robot in different scenarios. In case the Friedman test revealed significant differences, a pairwise Wilcoxon signed-rank test was applied afterwards, to identify significant differences between the individual scenario pairs. This test procedure was selected because of the same reasons stated above.

2. **Between cultures:** To test H1 (Task Over Culture), a cultural comparison between Austria and Japan was conducted. For this purpose the results from the previous step were compared for each scenario. Subsequently, a Mann-Whitney U test was used to assess the statistical significance of potential cultural variations. This test was chosen because, unlike the within-culture analysis, the cultural comparison involved independent groups (Austrian vs. Japanese participants), rather than repeated measures on the same participants.

5.2.1 Within Cultures

Austria

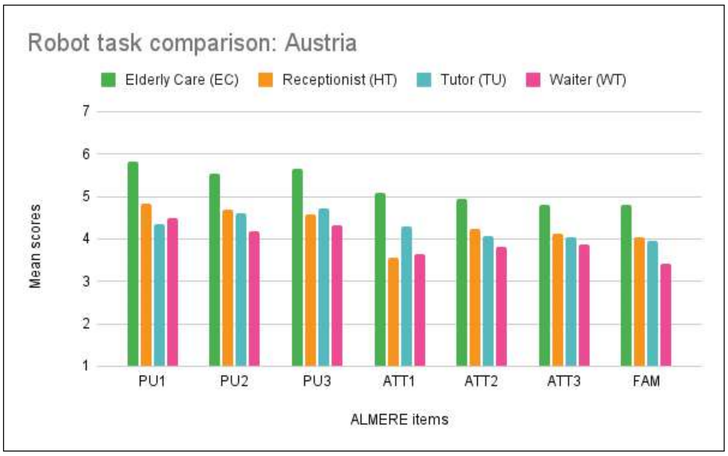

Figure 5.3: Austrian mean values of Almere questions relating to the four robot scenarios. Scores on a Likert scale from 1 (strongly disagree) to 7 (strongly agree). PU = Perceived Usefulness, ATT = Attitude towards technology, FAM = Family related attitude.

As shown in Fig.5.3, in Austria the companion robot for elderly people (EC) consistently received the highest ratings across all questions, particularly in terms of perceived usefulness with mean scores of 5.81 for PU1, 5.55 for PU2 and 5.65 for PU3. In contrast, the other roles (HT, TU, WT) were rated slightly lower in perceived usefulness across all three questions, with HT scoring a bit higher than TU and WT (see Table 5.5 for details). Regarding the remaining Almere questions (ATT1 - FAM), all roles received lower ratings compared to the perceived usefulness-dimension.

After applying a Friedman test to the seven Almere questions, a significant difference ($p < 0.05$) could be identified for all of them. Therefore a pairwise Wilcoxon signed-rank test was conducted for each question, to reveal between which roles the differences occured. In Table 5.3 the p-values derived from this test are presented and results displaying a significant difference between tasks ($p < 0.05$) are highlighted. The results confirm a significant difference between EC and the other three roles for all Almere items, with EC rated consistently higher than the other conditions. When comparing the other three roles with each other, only two questions showed significant differences: For ATT1 a significant difference could be observed as the TU role was rated higher than the service tasks HT ($p = 0.02878$) and WT ($p = 0.04327$). Further, a significant difference ($p = 0.04237$) within the service tasks was found for FAM, as the HT role was preferred over the WT robot.

Overall, the results of this section indicate a neutral to positive stance towards the four robot roles among Austrian participants, with a clear preference for the EC role over the tutor- or service tasks.

Perceived Usefulness (PU)									
	PU1			PU2			PU3		
	EC	**HT**	**TU**	**EC**	**HT**	**TU**	**EC**	**HT**	**TU**
HT	0.00563	-	-	0.01086	-	-	0.00104	-	-
TU	0.00084	0.16999	-	0.02064	0.95895	-	0.02223	0.66819	-
WT	0.00394	0.24891	0.66202	0.00555	0.33190	0.2346	0.00293	0.83190	0.23884

Attitude towards Technology (ATT)									
	ATT1			ATT2			ATT3		
	EC	**HT**	**TU**	**EC**	**HT**	**TU**	**EC**	**HT**	**TU**
HT	0.00023	-	-	0.01892	-	-	0.00422	-	-
TU	0.03179	0.02878	-	0.00818	0.68896	-	0.01205	0.66935	-
WT	0.00054	0.59924	0.04327	0.00187	0.11669	0.31155	0.00362	0.39927	0.54772

Attitude towards family members using the robot (FAM)			
	EC	**HT**	**TU**
HT	0.02094	-	-
TU	0.02210	0.85364	-
WT	0.00043	0.04237	0.05894

Table 5.3: Pairwise comparisons between task conditions (EC, HT, TU, WT) for Austrian ratings across Almere questions (PU, ATT, FAM), showing p-values from the Wilcoxon Signed Rank test. Highlighted cells indicate a statistically significant difference ($p < 0.05$).

Japan

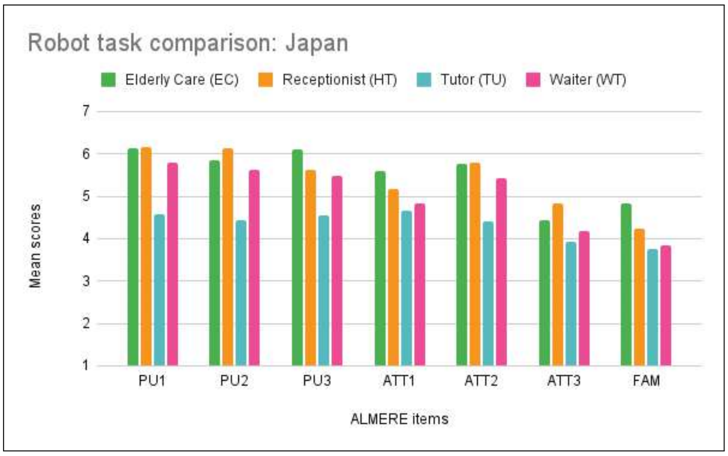

Figure 5.4: Japanese mean values of Almere questions relating to the four robot scenarios. Scores on a Likert scale from 1 (strongly disagree) to 7 (strongly agree). PU = Perceived Usefulness, ATT = Attitude towards technology, FAM = Family related attitude.

As shown in Fig.5.4, in Japan the tutor robot stood out for receiving the lowest ratings across all Almere questions, compared to the other roles. However, despite having the lowest overall scores, the TU robot still received neutral to slightly positive ratings for questions PU1 to ATT2, with mean scores around 4.5. Participants showed more disagreement with ATT3 and FAM, where mean scores were lower, at 3.93 and 3.77, respectively. A similar trend could be observed for the other roles, which were also rated higher in the first five Almere questions.

As the results from the Friedman test revealed significant differences ($p < 0.05$) for all Almere items, a pairwise Wilcoxon signed-rank test was conducted for each question. The results of this test revealed several interesting tendencies, some of which aligned with the Austrian results, while others differed. A visualization of all p-values from the test with highlighted significant differences can be seen in Table 5.4. The previously described differences between the TU role and the others could be confirmed by the test results. These differences were particularly evident in the perceived usefulness dimension, as well as in ATT2, where significant differences emerged when comparing the TU role with each of the others. P-values were particularly low for PU1 - PU3, indicating that the Japanese participants viewed the EC, HT and WT roles as more useful than the TU robot. However, these weren't the only items were significant differences emerged regarding the TU role. Like in Austria, significant differences could identified between the EC robot and the TU robot for all seven Almere questions, with particularly low p-values for PU1 ($p = 0.00008$) and PU3 ($p = 0.00007$). Moreover, the EC robot received significantly higher ratings than the WT role four times (PU1, PU3, ATT1, FAM), as well as two times it was rated higher than the HT role (PU3, FAM). These findings partially align with the Austrian tendency of favoring the EC robot. However, there were

Perceived Usefulness (PU)									
	PU1			PU2			PU3		
	EC	**HT**	**TU**	**EC**	**HT**	**TU**	**EC**	**HT**	**TU**
HT	0.84676	-	-	0.51763	-	-	0.02255	-	-
TU	0.00008	0.00003	-	0.00176	0.00005	-	0.00007	0.00077	-
WT	0.03490	0.01789	0.00066	0.36309	0.04847	0.00155	0.00306	0.33391	0.00800

Attitude towards Technology (ATT)									
	ATT1			ATT2			ATT3		
	EC	**HT**	**TU**	**EC**	**HT**	**TU**	**EC**	**HT**	**TU**
HT	0.12751	-	-	1.00000	-	-	0.40965	-	-
TU	0.00286	0.14464	-	0.00156	0.00067	-	0.03767	0.00436	-
WT	0.00345	0.81414	0.50093	0.16155	0.05276	0.0127	0.25357	0.06799	0.36888

Attitude towards family members using the robot (FAM)			
	EC	**HT**	**TU**
HT	0.02518	-	-
TU	0.00287	0.10225	-
WT	0.00095	0.15037	0.84484

Table 5.4: Pairwise comparisons between task conditions (EC, HT, TU, WT) for Japanese ratings across Almere questions (PU, ATT, FAM), showing p-values from the Wilcoxon Signed Rank test. Highlighted cells indicate a statistically significant difference ($p < 0.05$).

also questions where the HT robot received higher ratings than both the TU and WT roles (PU1, PU2, ATT3), indicating a possible preference for the HT role as well among Japanese participants.

In summary, the task comparison for the Japanese ratings revealed a couple of interesting preferences. Notably, significant differences emerged between the TU role and the other roles, with the TU role consistently receiving the lowest ratings. This trend was particularly distinct regarding the comparison with the EC role, which was favored over the TU role across all seven questions. Furthermore, there were additional cases were the HT role was preferred over TU and WT, which also highlight a more favorable attitude towards the HT role.

5.2.2 Between Cultures

After having identified the role-preferences within Austria and Japan separately, the results were compared to examine potential cross cultural variations. Clear differences could be observed for the receptionist robot scenario, as five out of seven questions received significant higher ratings in Japan than in Austria. All items in perceived usefulness were found to have p-values smaller than 0.5 (PU1: 0.00019, PU2: 0.00137, PU3: 0.00837), which indicates that the Japanese perceived the HT robot as more useful than Austrians. Furthermore, the items ATT1 and ATT2 showed p-values of 0.00042 and 0.00013 and therefore notable differences. The questions whether the participant would like to interact with the robot themselves (ATT3), or their family to interact with it (FAM) were rated similar by both countries between approximately 4 and 4.5 (see Table 5.5 for more info).

The same role variations could be observed for the waiter scenario, as Japanese rated the robot significantly higher for the first five items as well. Although the p-values were higher compared to the receptionist scenario in terms of perceived usefulness, the results still showed significant differences between Japan and Austria (PU1: 0.01416, PU2: 0.01137, PU3: 0.02596). The same goes for ATT1 and ATT2, were the Mann-Whitney U test revealed p-values of 0.00506 and 0.00029, respectively. No cultural differences were found for item ATT3 and FAM, which were averagely rated around 4 and 3.5.

While the service-oriented scenarios did show significant cultural differences (see Fig. 5.5), the highly sociable tasks like EC and TU were rated almost equally among Austrian and Japanese participants. Only one item showed a cultural variation: ATT1 “It is good if the robot is used in this context”, A = 4.94, J = 5.78). This item received a significantly higher rating in Japan compared to Austria, with a p-value of 0.01979.

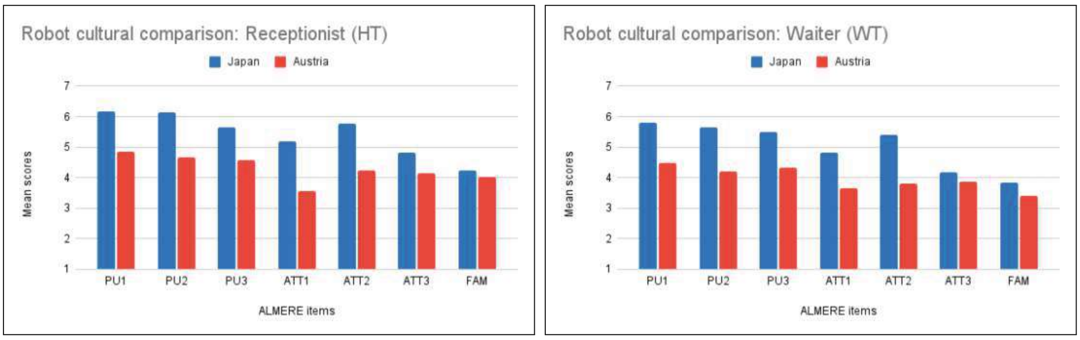

Figure 5.5: Comparison of Austrian and Japanese mean values for the receptionist and waiter robot scenarios. Scores on a Likert scale from 1 (strongly disagree) to 7 (strongly agree). PU = Perceived Usefulness, ATT = Attitude towards technology, FAM = Family related attitude.

Robot Scenarios		Austria			Japan		
		M	Md	SD	M	Md	SD
Companion For Elderly (EC)	PU1	5.81	6	1.223	6.13	6	0.860
	PU2	5.55	6	1.457	5.86	6	1.177
	PU3	5.65	6	1.404	6.10	6	0.885
	ATT1	5.10	5	1.535	5.59	6	1.240
	ATT2	4.94	5	1.548	5.78	6	1.424
	ATT3	4.81	5	1.905	4.43	5	1.775
	FAM	4.79	5	1.567	4.83	5	1.692
Receptionist (HT)	PU1	4.84	5	1.551	6.17	6	0.747
	PU2	4.68	5	1.796	6.14	6	0.907
	PU3	4.58	5	1.628	5.63	6	0.999
	ATT1	3.55	4	1.748	5.17	5	1.441
	ATT2	4.23	4	1.591	5.79	6	1.057
	ATT3	4.13	4	1.893	4.83	5	1.562
	FAM	4.03	4	1.239	4.24	4	1.527
Tutor (TU)	PU1	4.35	5	1.924	4.59	5	1.659
	PU2	4.61	5	1.801	4.45	5	1.571
	PU3	4.71	5	1.953	4.55	5	1.785
	ATT1	4.29	4	1.792	4.67	5	1.493
	ATT2	4.07	5	1.964	4.41	4	1.862
	ATT3	4.03	4	2.057	3.93	4	1.856
	FAM	3.97	4	1.822	3.77	4	1.755
Waiter (WT)	PU1	4.48	5	2.064	5.80	6	0.997
	PU2	4.19	4	2.167	5.63	6	1.189
	PU3	4.32	5	1.938	5.48	5	1.299
	ATT1	3.65	4	1.723	4.83	5	1.510
	ATT2	3.80	4	1.690	5.41	5	1.086
	ATT3	3.87	4	1.962	4.17	4	1.577
	FAM	3.41	4	1.658	3.83	4	1.605

Table 5.5: Mean (M), median (Md) and standard deviation (SD) of Almere questions regarding the 4 robot scenarios. Highlighted rows indicate a statistically significant difference ($p < 0.05$). Scores on a Likert scale from 1 (strongly disagree) to 7 (strongly agree). PU = Perceived Usefulness, ATT = Attitude towards technology, FAM = Family related attitude.

5.3 Perception of the robot

To measure the participant's perception of the robot, the Robotic Social Attributes Scale (RoSAS) [12] was included at the end of the survey. After watching the four robot scenarios, the participants had to rate the robot according to 18 characteristics, measuring the dimensions of *Warmth*, *Competence* and *Discomfort*. The statistical data is shown in Table 5.6 and mean values are illustrated in Figure 5.6. Again, Japanese and Austrian mean values will be abbreviated with J and A for an increased readability.

The analysis followed the same approach used for the GAToRS questionnaire: First, the mean scores were compared between Austria and Japan. Next, a Mann-Whitney U test was performed for each item to identify significant cultural differences. Finally, the same procedure was applied at the subscale-level (Warmth, Competence, Discomfort) and Cronbach's Alpha was was calculated for each subscale. The results for RoSAS revealed higher values compared to GAToRS, indicating a stronger internal consistency: Warmth AT = 0.89, JP = 0.69. Competence AT = 0.81, JP = 0.77. Discomfort AT = 0.81, JP = 0.78.

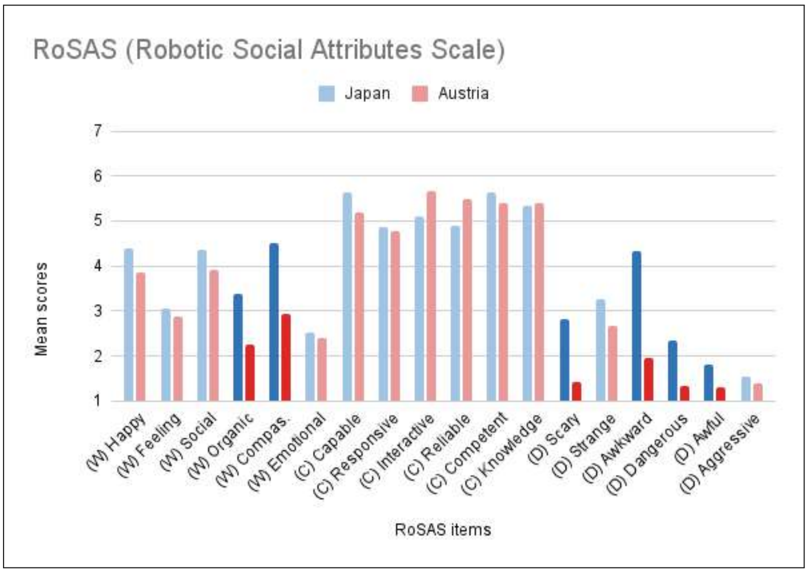

Figure 5.6: Mean values of RoSAS. Highlighted bars indicate a statistically significant difference. Scores on a Likert scale from 1 (strongly disagree) to 7 (strongly agree). W = Warmth, C = Competence, D = Discomfort.

Warmth

The perception of *Warmth* was rated similarly by Austrian and Japanese participants, as there was no significant difference found for most items. The robot was perceived equally low for *emotional* (A = 2.41, J = 2.53) and *feeling* (A = 2.87, J = 3.06) by participants of both countries. *Happy* (A = 3.83, J = 4.40) and *social* (A = 3.93, J = 4.37) received medium ratings.

The two items that showed a significant cultural difference were *organic* and *compassionate*. *Organic* was rated averagely with 2.26 in Austria and 3.37 in Japan, resulting in a significant difference with a p-value of 0.01276. For *compassionate*, the p-value was even lower (p = 0.00025), indicating a quite different perception of Austrians (A = 2.93) and Japanese participants (J = 4.52).

On a subscale level, there was no significant difference found (p = 0.06864), suggesting that there is no significant cultural difference in the perception of *Warmth* between Austria and Japan.

Competence

Compared to the dimension of *Warmth*, the *Competence* dimension received higher rating, with mean scores around 5 by both Austrian and Japanese participants. Austria showed slightly higher mean and median values for *interactive* (A = 5.67, J = 5.10) and *reliable* (A = 5.48, J = 4.90), while Japan perceived the robot slightly more *capable* (A = 5.20, J = 5.63), *responsive* (A = 4.77, J = 4.87), *competent* (A = 5.40, J = 5.63) and *knowledgeable* (A = 5.40, J = 5.34). However, the mean differences for all items were minimal, resulting in none of them reaching statistical significance.

Since no significant differences were found for any item in this dimension, there was also no variation observed at the subscale level (p = 0.46560). Both Austrian and Japanese participants showed the highest agreement in this dimension.

Discomfort

For the dimension of *Discomfort*, no significantly different ratings were observed for *strange* (A = 2.67, J = 3.27) and *aggressive* (A = 1.39, J = 1.53). The low mean scores, especially for *aggressive*, indicate that both countries didn't find these characteristics applicable.

However, there were significant differences found for the four remaining attributes. Very low p-values were computed for *scary* (p = 0.00007, A = 1.42, J = 2.83) and *awkward* (p = 0.0000000183, A = 1.97, J = 4.33), highlighting a significantly different perception of Austrian and Japanese participants. A slightly lower, but still significant variation was observed for *dangerous* (p = 0.00509, A = 1.32, J = 2.33) and *awful* (p = 0.00292, A = 1.40, J = 1.80), with Japanese participants also showing more agreement with these characteristics than Austrians.

As the majority of items showed significant variations between countries, there was also a highly significant difference found at the subscale-level (p = 0.000004). The higher mean scores of Japanese indicate a stronger perception of *Discomfort* compared to Austrians. This cultural difference was quite surprising, because although the SOTA robot was

RoSAS		Austria			Japan		
		M	Md	SD	M	Md	SD
Warmth	Happy	3.85	4	1.676	4.40	5	1.632
	Feeling	2.87	3	1.697	3.06	3	1.461
	Social	3.93	4	1.574	4.37	5	1.650
	Organic	2.26	2	1.483	3.37	3	1.623
	Compassionate	2.93	3	1.574	4.52	5	1.326
	Emotional	2.41	2	1.376	2.53	2	1.592
Competence	Capable	5.20	6	1.157	5.63	6	1.066
	Responsive	4.77	5	1.567	4.87	5	1.252
	Interactive	5.67	6	1.061	5.10	5	1.398
	Reliable	5.48	6	1.153	4.90	5	1.094
	Competent	5.40	6	1.276	5.63	6	1.129
	Knowledgeable	5.40	6	1.070	5.34	6	1.446
Discomfort	Scary	1.42	1	1.089	2.83	3	1.704
	Strange	2.67	3	1.184	3.27	3	1.437
	Awkward	1.97	2	1.080	4.33	5	1.422
	Dangerous	1.32	1	0.702	2.33	2	1.626
	Awful	1.30	1	0.794	1.80	2	0.887
	Aggressive	1.39	1	1.230	1.53	1	0.860

Table 5.6: Mean (M), median (Md) and standard deviation (SD) of RoSAS. Highlighted rows indicate a statistically significant difference ($p < 0.05$). Scores on a Likert scale from 1 (strongly disagree) to 7 (strongly agree).

created and produced by a Japanese company [71], the Japanese participants expressed higher discomfort towards it than Austrians.

CHAPTER 6

Discussion

6.1 The Role of Culture

In H1 it was assumed that task context will have a bigger influence than cultural background on our attitude towards robots. To check whether this assumption is correct, a SOTA robot was filmed in four different application scenarios and shown to Japanese and Austrian participants. After each video the participants answered the same seven questions inspired by the Almere model [24], to measure their attitude towards the robot and how useful they perceived it. According to H1, it was expected that the roles would be similarly rated by both countries, revealing cross-cultural task preferences for social robots. However, this assumption was only partially supported by the results. Although a clear preference for the EC robot over the TU robot was observed in Austria and Japan, only these two roles received similar ratings in both countries. Interestingly, both of these roles displayed the robot in a highly sociable context, namely a tutor for children and an companion for the elderly. Except for one item (ATT2) there were no significant cultural differences found between the EC and TU role. Therefore, it can be concluded that H1 holds true for this comparison, as the EC role was rated significantly higher than the TU role across all Almere questions in both Austria and Japan. This suggests that regarding the higher sociable task scenarios, the role context had a high influence on the participants' perceptions, regardless of their cultural background. In contrast, the results for the more service-oriented tasks (HT, WT) could not support H1, as cultural differences emerged. Both the waiter and receptionist Robot were rated significantly more useful and with a more positive attitude in Japan than in Austria. Furthermore, an interesting pattern could be observed: For both HT and WT the first five Almere questions (PU1 - ATT2) showed cultural differences, while the last two items ATT3 ("I would like to interact with the robot myself.") and FAM ("I would like my parents, or other close relatives, to interact with the robot.") were rated equally low in both countries. Furthermore, all four roles consistently received the lowest results in both countries for ATT3 and FAM. This finding may suggest that while both Japanese and Austrian participants are generally open to the idea of robots, they might be hesitant to use them personally or for those close to them.

Regarding the general attitudes towards robots (GAToRS) section, cultural differences as well was similarities could be observed. The most culturally diverse ratings emerged on a personal negative level (P-), suggesting that Japanese have a more negative attitude towards robots than Austrians, when it comes to personal interaction. The difference was especially high for items 6 ("I would feel uneasy if I was given a job where I had to use robots.") and 8 ("Robots scare me."), which were rated approximately 1.6 points higher in Japan. Other cultural differences could be identified on a societal positive level (S+), where two items (11 and 12) revealed a more positive attitude of Austrian participants towards the societal impact of robots. These results align with the previously discussed concerns about the societal impact of robots among Japanese people, identified in [7] and [40]. Apart from these differences, the ratings generally showed similar attitudes towards robots in both countries: On the P+ scale no strong cultural differences emerged, and the results showed a moderate to high level of trust in the development of robots and comfort in interacting with them. The results for S+ indicated a positive attitude among Austrian and Japanese participants on a societal level as well, receiving even higher ratings than P+. This suggests that participants from both countries may view the broader societal benefits of robots more favorably than their personal interactions with them. A similar tendency could be identified regarding negative attitudes, as societal-level concerns (S-) outweighed personal ones (P-), indicating that participants have a greater fear of robots' broader societal impacts than their immediate personal experiences with them.

After watching the four robot scenarios, the participants had to rate the social attributes of the SOTA robot they had just watched. For the dimensions of *Warmth* and *Competence*, the attributes of the robot were rated very similarly by Japanese and Austrians. Both rated the robot low to medium in terms of *Warmth*, although Japanese perceived it as slightly more *organic* and *compassionate*. The *Competence* dimension was rated the highest among the three, with ratings around 5 for all items in both countries. This reflects a strong perception among both Austrians and Japanese participants regarding attributes associated with *Competence*. The most cultural differences emerged in the *Discomfort* dimension, as Austrian participants generally reported low discomfort with robots, whereas Japanese participants expressed slightly higher discomfort across four attributes. (*scary*, *awkward*, *dangerous*, *awful*). Particularly, the attribute *awkward* was rated more than double in Japan than in Austria. These results are surprising, given the Japanese origin of the robot and therefore its presumed wider usage in Japan than in Austria. However, this aligns with the results in studies like [40], which showed that Japanese don't feel warmer towards robots than US citizens. Also in [22] it could not be proven that Japanese have less fears or more positive attitudes when it comes to robots, than people from European countries. Therefore, this thesis reveals that while both Japanese and Austrians generally perceive the SOTA robot as competent, their views on warmth and especially discomfort vary, with Japanese participants showing slightly more concerns about potential discomforts.

6.2 The Role of Task Context

Although H1 *Task over culture* was not fully supported by the findings, there is no denying that a robot's application context influences our opinion and perception of it. With showing the videos of a social robot in four different application scenarios to the participants, it could be proven that Austrian as well as Japanese participants did indeed prefer some robot tasks over others. But what do the results of this section mean for H2 *Service tasks over social tasks*? Because of the findings in [55] and [65], the second hypothesis proposed that a robot performing general service tasks would receive more positive ratings by Austrians and Japanese, compared to a robot in roles that involve higher levels of social interaction. Since food ordering and hotel check-in tasks follow relatively fixed structures and are therefore possible to automate, a waiter and a receptionist robot were selected to represent the service-oriented roles. For the higher-level social tasks, a companion robot for the elderly and a tutor robot were selected, as care-giving and teaching require more nuanced interactions involving creativity, emotional support, and adaptive problem-solving. Additionally, these roles addressed two vulnerable user groups: the elderly and children.

In Japan the results of the Almere questions support H2 when comparing the tutor robot with the service-oriented roles of the waiter and hotel receptionist. Especially in terms of perceived usefulness, but also regarding the general attitude towards technology, the TU role received significant lower ratings. However, since the EC robot received higher ratings than the WT robot in four cases and outperformed the HT robot in two, while receiving equal ratings in other cases, this finding challenges the assumption made in H2. In addition, the EC robot achieved significantly higher scores than the TU robot for all seven Almere questions, indicating a previously unexpected preference within the social roles. Another possible preference was also discovered within the service-oriented roles, with the HT robot being rated higher than the WT robot for PU1, PU2 and ATT3. In Austria the preference for the EC role was even stronger. Not only did it receive higher ratings than the TU role across all seven questions, but also it was rated significantly higher than both the waiter and receptionist roles. Apart from the strong preference for the EC role over the others, only two additional role-based differences were observed. The Japanese preference for the HT robot over the WT robot was mirrored only once in the Austrian results (FAM). Conversely, in the ATT1 category, the TU role was rated higher than both the HT and WT roles by the Austrian participants. Otherwise, the tutor robot received similar ratings to the service-oriented roles.

The findings from the Almere section were further validated in the post-questionnaire, where participants were asked to identify and explain their most and least favorite robot roles (only one role could be chosen) after viewing all of the robot videos. These two questions aimed to provide deeper insights into the reasoning behind the participants' ratings of the robots. In Fig.6.1 we see that in Austria the EC robot was selected as "the best" by the most participants (18 out of 31), while the other roles were chosen significantly less often (HT:4, TU: 3, WT: 1, no role: 5). This corresponds to the results of the Almere questions. Regarding the identified trends in Japan, the lower ratings for the tutor robot were reflected in the post questionnaire results, with 17 out of 30 participants selecting it as their least favorite role. Moreover, the preference towards the EC robot could be confirmed, as it received 12 votes for "the best role" in the post-questionnaire. The EC role was closely followed by the HT role with 11 votes, strengthening the observed preference for the HT robot that emerged in the Almere section. However, when looking at Fig.6.1, an additional trend that was not evident before could be identified. Previously, no distinct least favorite role had emerged in Austria, as the TU, HT, and WT roles were rated similarly in most cases. Despite this, in the post-questionnaire the tutor role was chosen the most frequently (14 out of 31 votes) while both the waiter and hotel receptionist roles received only 6 votes each. At this stage, participants had viewed all the videos and were required to compare the roles against one another, which differs from the earlier phase when they focused only on one role at a time. This could be a possible explanation for why this trend did not emerge earlier. Additionally, since participants were limited to voting for only one robot for each question, it is likely that some may have preferred to select two or more options. This could have resulted in findings even more aligned with those observed in the Almere section.

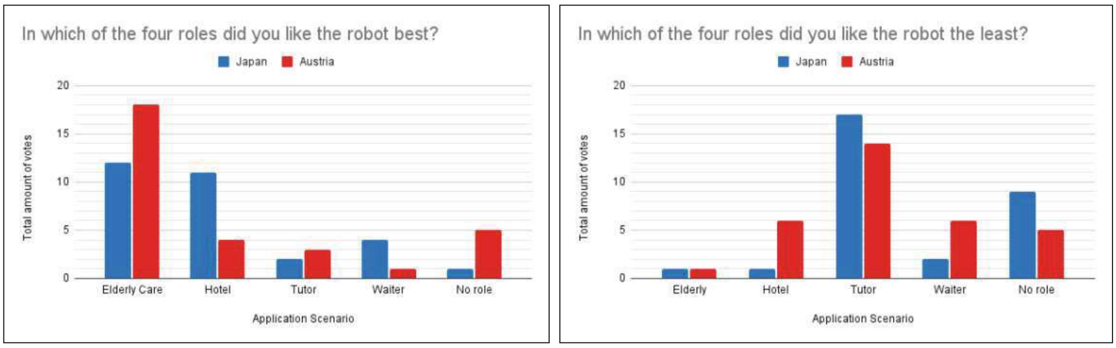

Figure 6.1: Results of the post questionnaire, giving an additional comparison between the four roles.

This second role-comparison in the post-questionnaire also provided a deeper insight into the reasoning behind the participants' choices. In both Japan and Austria, participants emphasized the importance of human interaction, particularly for children. They noted that real people are better suited for educational settings, as they can better respond to students individual needs than a robot. In Austria, participants further suggested that while a tutor robot could be useful as a support tool at home or alongside a human teacher, it should not serve as a replacement for human educators. Interestingly, the EC robot was less seen as representing a replacement for humans, with many participants describing it as a valuable supplement to the limited human interaction elderly people often experience. Participants from both cultures recognized the benefit of having a robot to assist with medication reminders. While Austrians highlighted the significant value of the EC robot due to the shortage of human caregivers, Japanese participants noted that it could also ease the burden on relatives who care for their elderly family members. Although Japan's elderly care system is gradually transitioning from family-based to facility-based support [63], this observation illustrates an example where elderly individuals are still receiving care from their family members. A further remark by an Austrian participant pointed out that the EC robot showed similarities with already widely used smart home technologies. As a negative aspect, a Japanese participant stated that they don't think it would be enjoyable to interact with the EC robot on a daily basis. Regarding the comments on the WT robot, an interesting divergence emerged among the Austrian participants. Some emphasized that being in a restaurant is a highly social experience, making human interaction essential. In contrast, others argued that the robot provided no added value and suggested a simple tablet would be sufficient instead. The same argument was raised concerning the hotel robot. In Japan, the service-oriented roles received more positive feedback, with participants describing them as smooth, realistic, and even more efficient and accurate than human workers. One participant also highlighted the advantage of robots for anxious customers, noting that it might be easier for them to place orders with a robot. Another participant mentioned they already had a positive experience with a robot receptionist, suggesting that this prior encounter with the robot had influenced their decision.

Looking at the identified role preferences in Japan, intersections with the findings of existing literature can be found. In [47], Japanese participants also preferred using robots operating in a hotel reception and nursing care context over those doing education related tasks. Additionally the results from [65], which revealed a preference for robots performing tasks involving memorization and perceptual skills over those requiring evaluation, align with the Japanese participants' preference for the service-oriented roles over the tutor role. It can also be argued that this preference extends to the elderly care companion, as the EC robot scenario primarily focused on task reminders and appointment management, aligning with the preference for robots handling routine, memory-based functions. Given the absence of research specifically addressing Austrian preferences for social robot roles, no direct comparison with existing literature can be made. Therefore the found preference for the EC robot over the other roles is particularly interesting and offers new insights into this research area in Austria.

6.3 Limitations

This study has several limitations that should be acknowledged. First, participants were only able to view videos of the robot rather than engaging in direct, hands-on interactions. Moreover, in the videos the human user was only represented by a voice, generated by a text to speech engine. Although it was tried to use as natural voices as possible, this may have affected the participants' perceptions of the human's social presence when interacting with the robot. Ideally, participants would have interacted with the robot themselves to form more accurate impressions, however due to time constraints and the geographical distance between Austria and Japan this was not possible. Nevertheless, research such as [34] suggests that a robot represented only by video does not necessarily causes different responses than a physically present one. Second, the sample size was relatively small, with only 31 Austrian and 30 Japanese participants. A larger sample size would have been beneficial to achieve more robust results. Additionally all participants were students with technical educational backgrounds, which limits the generalizability of the findings to broader populations. However this homogeneity was beneficial for a controlled cross-cultural comparison and provided valuable insights into the perspectives of Austrian and Japanese technical students. Despite these limitations, this study provides a useful first glimpse into understanding cross-cultural perspectives related to task preferences and attitudes towards robots in Japan and Austria.

CHAPTER 7

Conclusion and Future Work

This study provided valuable insights into cross-cultural perceptions and attitudes towards social robots, comparing responses from Austrian and Japanese technical students. It specifically focused on examining the influence of task context on our perception of robots and wanted to find out, *if a robot's task has a greater impact on participants' attitudes towards it, than the participant's cultural background* (H1). For this reason, a SOTA robot was programmed and filmed in four different application scenarios, where two of them displayed the robot in more service-oriented roles (hotel receptionist, waiter), while the other two showed it operating in a more social context (companion for the elderly, tutor for children). Furthermore it was expected, that *both Austrian and Japanese participants will prefer the robot carrying out a general service task (waiter, receptionist) versus a higher sociability task including a vulnerable person (child, elderly person)* (H2).

The first hypothesis H1 was partially supported, as the results revealed that Austrian and Japanese participants had similar ratings of the tutor robot and the companion for the elderly, in terms of their perceived usefulness and their attitudes towards the usage of the robot. Furthermore they displayed the same role preferences, namely preferring the robot in the EC context over the TU. However, regarding the service-oriented roles, the responses from Austrians and Japanese differed, as the robot was rated significantly more positive operating in a receptionist- and waiter context among Japanese participants. Therefore, it could not be demonstrated that task context has a bigger influence than cultural background, nor could the opposite be proven. Nevertheless, the results indicate that a robot's application context does affect our perception of it, and certain role preferences may be shared across different cultures.

The second hypothesis H2, suggesting that service tasks (HT, WT) would be preferred over social tasks (EC, TU) by both countries was also not fully supported. Although the service roles were rated higher than the TU role in Japan, they could not outperform the EC role, which was rated even higher in some cases. This preference for the EC role was further reflected in the Austrian results, where it received significant higher ratings than all other tasks, further challenging the hypothesis. Nevertheless, valuable observations could be made: There was a notable distinction in how the social roles of EC and TU were rated, since in both countries the EC robot was rated significantly higher than the TU robot. This preference was not only shown in the Almere section, but further replicated in the post questionnaire. Although participants mentioned the importance of human contact for both social roles, they viewed the EC robot as an addition to human contact and feared that the TU robot would replace it. One possible explanation for this preference is, that the acceptance of robots performing social tasks may depend on the user, with tasks involving elderly individuals being more accepted than those involving children. However, further research is needed to determine if this assumption holds true.

The findings of this survey not only explored task related preferences, but also provided a glimpse into the general attitudes towards robots in Austria and Japan. The GAToRS section revealed that in both countries societal benefits and concerns outweigh personal ones. Austrians and Japanese showed neutral attitudes towards their personal interactions with robots, with the Japanese expressing a slightly more negative attitude towards robots than Austrians. Both countries acknowledged the societal benefits that robots can bring, demonstrated by the high ratings especially in Austria. However, participants also expressed strong agreement that robotics should be closely monitored, as unregulated use could lead to societal upheavals. Furthermore, the ratings from the Almere section suggest that although both Japanese and Austrian participants are generally open to the idea of robots, they might be hesitant when it comes to personally using them. As for the perception of the utilized SOTA robot, *Competence* was rated highly, *Warmth* was regarded as neutral and *Discomfort* was rated the lowest. Japanese participants reported feeling more discomfort than Austrians, although they did not express strong agreement regarding the *Discomfort* dimension overall.

This research brings further insights into the factors that influence perceptions of social robots and contribute to the knowledge base in both Austria and Japan. Future studies should explore the underlying reasons behind the greater willingness to accept robots as companions for the elderly, compared to robots tutoring children. Furthermore, the cultural differences observed in relation to service-oriented roles require a deeper investigation to uncover the underlying reasons for these discrepancies. Although it is important to consider expanding the sample size and incorporating a more diverse range of participants in real-life interactions in future research, this study contributes valuable insights into attitudes towards robots in both Austria and Japan, as well as the perceptions of social robots across different application contexts.

Overview of Generative AI Tools Used

The following AI tools were used for this work: Elicit (free version) is an AI-powered literature search tool and was partially used to search for related research papers. The AI tools ChatGPT-4 (version 4.0) and DeepL (free version) were also used for translation and paraphrasing purposes, but primarily served as inspiration and were never used for content creation.

Übersicht verwendeter Hilfsmittel

Für diese Arbeit wurden die folgenden KI-Tools verwendet: Elicit (gratis version) ist ein KI-gestütztes Literaturrecherche-Tool und wurde teilweise für die Suche nach verwandten Forschungsarbeiten verwendet. Die KI-Tools ChatGPT-4 (Version 4.0) und Deepl (gratis version) wurden ebenfalls für Übersetzungs- und Paraphrasierungszwecke verwendet, dienten aber eher der Inspiration und nie der Erstellung von Inhalten.

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Appendices

Robot Scenarios - Dialogue

Tutor	German	English	Japanese
Time: AT - 01:08 JP - 01:17	TR: Guten Morgen! Willkommen zur heutigen Englischstunde. Heute werden wir mit einer kurzen Wiederholung beginnen. Bist du bereit?	TR: Good morning! Welcome to today's english lesson. Today we will start with a short revision. Are you ready?	おはようございます！今日の英語のレッスンにようこそ。今日は簡単な復習から始めます。準備はいいですか？
	S: Ja!	S: Yes!	はい！
	TR: Okay! Beim letzten Mal haben wir gelernt, uns vorzustellen und über unsere Hobbys zu sprechen. Das wollen wir jetzt noch einmal üben. Bitte stell dich auf Englisch vor.	TR: Okay! Last time we learned about introducing ourselves and talking about our hobbies. Let's practice that again. Please introduce yourself in english.	オーケー！前回は自己紹介と自分の趣味について話すことを学びました。もう一度練習しましょう。英語で自己紹介をしてください。
	S: Hello! My name is Laura. I live in Vienna and I am ten years old. I like dancing and singing. Nice to meet you!	S: Hello! My name is Laura. I live in Vienna and I am ten years old. I like dancing and singing. Nice to meet you!	S: haloo mai neimu is ミア. i libe in tokyo and i amu sebun iyaazu old. i like dancing and singing. naisu tuu miit yuu.
	TR: Sehr gut! Lass uns jetzt über unsere Familie reden. Hast du Geschwister?	TR: Very good! Now let's talk about our family. Do you have any siblings?	とてもいいよ！では家族の話をしましょう。兄弟はいますか？
	S: Ja, ich habe einen Bruder.	Student: Yes, I have a brother.	はい、兄がいます！
	TR: Okay. Das englische Wort für Bruder ist "brother". Bitte sprich mir nach: "Brother".	TR: Okay. The english word for brother is "brother". Please repeat after me: "Brother".	なるほど。兄は英語で「brother」と言います。私の後に繰り返してください. "brother"
	S: Brother.	S: Brother.	S: Brother.
	TR: Gut! Jetzt wollen wir einen Satz bilden. Um "Ich habe einen Bruder" zu sagen, sagt man folgendes. "I have a brother". Bitte sprich mir nach: "I have a brother".	TR: Good! Now let's form a sentence. To say "I have a brother" you simply say "I have a brother". Please repeat after me: "I have a brother".	いいですね！では、文章を作ってみましょう。「私には兄がいます」は「I have a brother」と言います。私の後に繰り返してください:「I have a brother」
	S: I have a brother.	S: I have a brother.	S: I have ア brother..
	TR: Gut gemacht!	TR: Well done!	よくできました！

Companion for the elderly	**German**	**English**	**Japanese**
Time: AT - 01:09 JP - 01:12	CR: Guten Morgen Maria! Es ist Zeit für deine Morgen Medizin.	CR: Good morning Maria! It's time for your morning medication	ひなたさん、おはようございます！朝のお薬の時間です。
	M: Danke für die Erinnerung. Wie viele Tabletten waren es noch gleich?	M: Good morning! Thanks for reminding me. How many pills was it again?	おはよう！思い出させてくれてありがとう。なん錠飲むのでしたっけ？
	CR: Es sind zwei Tabletten am Morgen und eine Tablette am Abend. Nimm sie am besten mit einem Glas Wasser ein.	CR: It's two pills in the morning and one in the evening. It's best if you take them with a glass of water.	朝2錠、夕方1錠です。コップ1杯の水と一緒に飲むといいです。
	M: Wird gemacht! Übrigens, habe ich heute besondere Termine?	M: Will do! By the way, do I have any special appointments today?	わかりました！ところで、きょうは何か特別な予定があるのかな？
	CR: Lass mich deinen Tagesplan überprüfen… Du hast heute einen Arzttermin um 14 Uhr und am Abend läuft deine Lieblingsserie im Fernsehen. Das sind alle Einträge für heute.	CR: Let me check your schedule… You have a doctor's appointment today at 2pm and your favorite show is on TV in the evening. That's all the entries for today.	スケジュールを確認させてください... 今日は午後2時に医者の予約があり、夕方には 好きな番組がテレビで放映されます。今日のスケジュールは以上です
	M: Ohh richtig, hätte ich fast vergessen. Bitte erinner mich eine Stunde davor nochmal an meinen Arzttermin.	A: Oh, right. I almost forgot. Please remind me again one hour before my doctor's appointment.	そうだった。忘れるところだったわ。診察の1時間前にもう一度言ってください
	CR: Okay, ich werde dich um 13 Uhr daran erinnern. Gibt es sonst noch etwas Bestimmtes, das du vor dem Termin tun oder besprechen möchtest?	CR: Okay! I will remind you at 1pm. Is there anything else you want to do or talk about before your appointment?	わかりました！午後1時にまた連絡します。予約の前に何かしたいこと、話したいことはありますか？
	M: Lass uns ein bisschen quatschen, während ich mein Frühstück esse.	M: Hmm let's chat a bit while I'm having breakfast!	朝食を食べながら、少し話をしませんか？
	CR: Sehr gern! Gibt es etwas Bestimmtes, worüber du reden möchtest?	CR: With pleasure! Is there anything specific you want to talk about?	喜んで！何か話したいことはありますか？
	A: Bitte erzähl mir von den kommenden Veranstaltungen in meiner Nachbarschaft.	A: Please tell me about the upcoming events in my neighborhood.	近所でこの先に開催される予定の催しについて教えてください。
	CR: Okay!	CR: Okay!	わかりました！

Hotel Receptionist	German	English	Japanese
Time: AT - 01:05 JP - 01:16	RR: Hallo! Ich werde Ihnen heute beim Einchecken helfen. Bitte sagen Sie mir Ihren vollständigen Namen.	Hello! I will assist you with your checkin today. Please tell me your full name.	RR: いらっしゃいませ！今日のチェックインをお手伝いします。お客様のフルネームを教えてください。
	A: Anna Stein.	A: Anna Stone.	A: 山本奈々です。
	RR: Willkommen in unserem Hotel, Frau Stein! Laut meinem System haben Sie eine Reservierung für eine Person von heute bis Mittwoch dem 15.ten gemacht. Ist das korrekt?	RR: Welcome to our Hotel Mrs. Stone! According to my system you have made a reservation for one person from today until Wednesday the 15th. Is that correct?	RR: 山本様、ようこそ当ホテルへ！本日から15日水曜日まで、お一人様分のご予約をされているようですね。よろしいでしょうか？
	A: Ja, das ist richtig.	A: Yes, that's correct.	A: そう、その通りです。
	RR: Okay. Bitte zeigen Sie mir einen Ausweis, z.B. einen Führerschein oder einen Reisepass, indem Sie ihn vor meinen Kopf halten.	RR: Okay. Please show me a form of identification, such as a driver's license or passport, by holding it in front of my head.	RR: わかりました。運転免許証やパスポートなどの、身分証明書を見せてください。そしてそれを私の顔の前に掲げてください。
	A: Okay hier bitte.	A: Sure, here you go.	A: はい、どうぞ。
	RR: Vielen Dank. Ihre Daten werden gerade bearbeitet. Während wir Ihren Check-in abschließen, möchte ich Ihnen einige wichtige Informationen mitteilen. Das Frühstück wird von 7.00 bis 10.00 Uhr serviert und checkout ist um 11.00 Uhr. Haben Sie sonst noch Fragen?	RR: Thank you. Your information is being processed. While we finalize your check-in, let me share some important information. Breakfast is served from 7 AM to 10 AM and our checkout time is 11 AM. Do you have any more questions?	RR: ありがとうございました。お客様の情報をただいま処理しています。チェックインの最終確認をしている間に、重要なお知らせをさせていただきます。朝食は午前7時から午前10時まで、チェックアウトは午前11時です。他にご質問はございませんか？
	A: Nein danke, ist alles klar.	A: No thanks, everything is clear.	A: 結構です。
	RR: Okay! Ihr Check-in ist nun abgeschlossen. Wenn Sie doch noch etwas benötigen, lassen Sie es mich bitte wissen. Genießen Sie Ihre Zeit in unserem Hotel!	RR: Okay! Your check-in is now complete. If you need anything else, please let me know. Enjoy your time at our hotel!	RR: わかりました！これでチェックインは完了です。何かございましたら、お申し付けください。当ホテルでのご滞在をお楽しみください！

Restaurant Waiter	**German**	**English**	**Japanese**
Time: AT - 01:05 JP - 01:10	WR: Hallo und willkommen! Was möchten Sie essen?	WR: Hello and welcome! What do you want to eat?	WR: いらっしゃいませ! 何をお食べになりますか?
	A: Einmal Spaghetti Carbonara bitte.	A: Hello! One spaghetti carbonara, please.	A: スパゲッティ・カルボナーラを1つください。
	WR: Einmal Spaghetti Carbonara, habe ich das richtig verstanden?	WR: One spaghetti carbonara, did I understand that correctly?	WR: スパゲッティ・カルボナーラ1つですね。これで正しいでしょうか？
	A: Ja.	A: Yes.	A: はい
	WR: Okay! Möchten Sie dazu noch einen Beilagensalat?	WR: Okay! Would you like a side salad with that?	WR: わかりました！サイドサラダはいかがですか？
	A: Ja bitte.	A: Yes please.	A: はい、お願いします。
	WR: Okay, ich habe einen Beilagensalat zu Ihrer Bestellung hinzugefügt. Was möchten Sie trinken?	WR: Okay, I added one side salad to your order. What would you like to drink?	WR: はい、サイドサラダをひとつ追加しました。お飲み物は何になさいますか?
	A: Cola bitte.	A: Cola, please.	A: コーラをお願いします。
	WR: Okay! Ich fasse Ihre Bestellung zusammen. Einmal Spaghetti Carbonara, einmal Beilagensalat, einmal Cola. Gibt es noch etwas, was Sie Ihrer Bestellung hinzufügen möchten?	WR: I will summarize your order. One spaghetti carbonara, one side salad, one cola. Is there anything else you'd like to add to your order?	WR: 注文をくりかえします。スパゲッティ・カルボナーラ1つ、サイドサラダ1つ、コーラ1つ。他にご注文に追加したいものはありますか？
	A: Nein danke, das war's.	A: No, that's it.	A: いや、それで結構です。
	WR: Okay. Das macht insgesamt 20 €, möchten Sie bar oder mit Karte bezahlen?	WR: Okay. That makes a total of 20€, would you like to pay by cash or card?	WR: わかりました。合計二千円になりますが、お支払いは現金とカードのどちらになさいますか？
	A: Mit Karte, bitte.	A: Card, please.	A: カードでお願いします。
	WR: Bitte stecken Sie Ihre Karte in das Kartenterminal.	WR: Please insert your card into the card terminal.	WR: カードをカード 端末に挿入してください
	WR: Die Zahlung war erfolgreich, vergessen Sie nicht Ihre Rechnung und Bestellnummer mitzunehmen! Genießen Sie Ihr Essen!	WR: Payment succeeded, don't forget to take your receipt and order number! Enjoy your meal!	WR: お支払いが完了しました。レシートと注文番号をお忘れなく！ お食事をお楽しみください！

GAToRS Translation

German	English (Original)	Japanese
1. Ich kann Personen und Organisationen vertrauen, die mit der Entwicklung von Robotern zu tun haben.	1. I can trust persons and organizations related to development of robots	1. ロボット開発関係者・団体を信頼できる。
2. Personen und Organisationen, die mit der Entwicklung von Robotern zu tun haben, berücksichtigen die Bedürfnisse, Gedanken und Gefühle ihrer Benutzer.	2. Persons and organizations related to development of robots will consider the needs, thoughts and feelings of their users	2. ロボット開発関係者・団体は、利用者のニーズ・考え・気持ちを考えてくれる。
3. Ich kann einem Roboter vertrauen.	3. I can trust a robot	3. ロボットを信頼できる。
4. Ich würde mich im Gespräch mit einem Roboter wohl fühlen.	4. I would feel relaxed talking with a robot	4. ロボットとならリラックスして話せる。
5. Wenn Roboter Gefühle hätten, könnte ich mich mit ihnen anfreunden.	5. If robots had emotions, I would be able to befriend them	5. ロボットに感情があれば、仲良くなれると思う。
6. Ich würde mich unwohl fühlen, wenn ich einen Job bekäme, bei dem ich mit Robotern arbeiten müsste.	6. I would feel uneasy if I was given a job where I had to use robots	6. ロボットを使う仕事を任されたら不安になる。
7. Ich befürchte, dass ein Roboter meine Befehle nicht verstehen würde.	7. I fear that a robot would not understand my commands	7. ロボットが私の命令を理解できるか心配だ。
8. Ich habe Angst vor Robotern.	8. Robots scare me	8. ロボットが怖い。
9. Ich wäre sehr nervös, wenn ich in der Nähe eines Roboters wäre.	9. I would feel very nervous just being around a robot	9. ロボットのそばにいるだけでとても緊張する。
10. Ich möchte nicht, dass ein Roboter mich berührt.	10. I don’t want a robot to touch me	10. ロボットに触られたくない。
11. Roboter sind notwendig, weil sie Arbeiten erledigen können, die für Menschen zu schwer oder zu gefährlich sind.	11. Robots are necessary because they can do jobs that are too hard or too dangerous for people	11. ロボットが必要なのは、人間には難しすぎる、あるいは危険すぎる仕事をやってくれるからだ。
12. Roboter können das Leben einfacher machen.	12. Robots can make life easier	12. ロボットは生活を便利にしてくれる。
13. Die Übertragung von Routineaufgaben an Roboter ermöglicht es den Menschen, sinnvollere Aufgaben zu erledigen.	13. Assigning routine tasks to robots lets people do more meaningful tasks	13. 定型的な仕事をロボットに任せることで、人はより有意義な仕事をすることができる。
14. Gefährliche Aufgaben sollten in erster Linie von Robotern übernommen werden.	14. Dangerous tasks should primarily be given to robots	14. 危険な仕事は主にロボットに任せるべきだ。
15. Roboter sind eine gute Sache für die Gesellschaft, weil sie den Menschen helfen.	15. Robots are a good thing for society, because they help people	15. ロボットは社会にとって良いことだ。
16. Roboter könnten uns noch fauler machen.	16. Robots may make us even lazier	16. ロボットは私たちをより怠惰にするかもしれない。
17. Der weit verbreitete Einsatz von Robotern wird den Menschen Arbeitsplätze wegnehmen.	17. Widespread use of robots is going to take away jobs from people	17. ロボットの普及は人々の仕事を奪うだろう。
18. Ich befürchte, dass Roboter zu weniger Interaktion zwischen Menschen führen werden.	18. I am afraid that robots will encourage less interaction between humans	18. ロボットが人間同士の交流を減らすことを恐れている。
19. Die Robotik ist einer der Bereiche der Technologie, die genau überwacht werden müssen.	19. Robotics is one of the areas of technology that needs to be closely monitored	19. ロボット工学は、注意深く監視する必要がある技術分野のひとつである。

GAToRS Translation

German	English (Original)	Japanese
20. Der unkontrollierte Einsatz der Robotik kann zu gesellschaftlichen Veränderungen führen.	20. Unregulated use of robotics can lead to societal upheavals	20. ロボット工学の無秩序な使用は、社会の混乱を招く可能性がある。

RoSAS Translation

German	English (Original)	Japanese
Glücklich	Happy	楽しい
Gefühlvoll	Feeling	感情がある
Sozial	Social	社交的な
Organisch	Organic	有機的な
Mitfühlend	Compassionate	思いやりがある
Emotional	Emotional	感情的な
Fähig	Capable	有能な
Reaktionsschnell	Responsive	反応のある
Interaktiv	Interactive	対話的な
Zuverlässig	Reliable	信頼できる
Kompetent	Competent	有能な
Sachkundig	Knowledgeable	物知りな
Beängstigend	Scary	怖い
Seltsam	Strange	奇妙な
Unangenehm	Awkward	ぎこちない
Gefährlich	Dangerous	危険な
Furchtbar	Awful	ひどい
Aggressiv	Aggressive	攻撃的な