INVESTIGATING USER EXPERIENCE OF HRI IN THE CONTEXT OF A REALISTIC RETAIL SCENARION: THE INFLUCE OF CONSUMER AGE ON THE EVALUATION OF A HUMANOID SERVICE ROBOT

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ABSTRACT

The fields of humanoid service robotics and human-robot interaction are interdisciplinary domains that are increasingly gaining momentum in practice and academia. However, as it is a relatively new area of interest in retail contexts, there are unanswered questions and challenges. The aim of this study is to (1) investigate and evaluate the user experience and satisfaction of consumers in human-robot interactions in a retail scenario and (2) analyze the interaction between consumers' age and satisfaction with their user experience with humanoid service robots. For this purpose, quantitative data was collected using a questionnaire filled out by customers of a shopping mall after they had interacted with a social robot of the model 'Pepper'. The results suggest that consumers tend to evaluate their interaction experience positively and satisfactorily. In addition, age was found to have a significant impact on consumers' satisfaction with the robot, with younger participants tending to be more satisfied with the interaction than more senior ones. These results may have implications for the design of service robots and how innovative customer journeys may improve the attractiveness and satisfaction of retail shopping for consumers in different age groups.

INTRODUCTION

The retail industry relies heavily on the possibility of offering individual services to customers and addressing their needs. This value proposition has been challenged by a variety of safety measures due to the Covid19 pandemic, such as social distancing, which has led to a change in consumer shopping behavior (Priluck, 2023). Brick-and-mortar retail has been particularly affected (OECD, 2020), as its business model relies heavily on human-to-human interaction and its associated potential benefits, for example in terms of customer bonding (Saxby et al., 2015). Thus, the retail industry had to come up with creative solutions. As technology is increasingly being used for in-person encounters to improve the quality of interactions (Nowak et al., 2023), one approach that is continuously gaining traction is the employment of humanoid service robots.

Research and industry have applied robots in manufacturing domains for many years. Here processes and workflows are more standardized and predictable. The application of robots in service domains, however, is a younger research field that has recently received more attention (Huang & Rust, 2018).

There is a growing body of research and literature that deals with service robots in service domains. However, there are still gaps related to data from realistic scenarios, as most studies are conducted in laboratory (Feil-Seifer et al., 2020) and healthcare settings (Bruna, 2011; Kim et al., 2013; Torta et al., 2013).

With respect to retail, recent studies investigated human-robot interaction and how customers' attitudes and shopping practices may be addressed by robots (Vaziri et al., 2020; Golchinfar et al., 2022; Niemelä et al., 2019; Heikkilä et al., 2019). Following the current research, it seems that service robots have the potential to support specific retail processes and customer interactions and further improve the experiences of customers. However, user

experiences of human-robot interactions (HRI) are influenced by a variety of different factors (Barnett et al., 2014; de Graaf & Ben Allouch, 2013; Young et al., 2011). Here, it seems that age is an important but not yet sufficiently studied predictor for the perceived user experience of service robots (Strait et al., 2015) and that different research settings have to be investigated.

This leads to the following research question: How do consumers assess their user experience and satisfaction with service robots in settings like a realistic retail scenario and what impact does age have on this assessment? The answer to this question could be relevant for designers and developers to gain a subtle understanding of the interactions between age and customer experience concerning HRI in retail domains as this could facilitate a customer-centered design of robot systems. Further, age is an often-used factor for the definition and description of target groups. Therefore, the results in this article address researchers and designers of service robots on the one side, but marketers designing innovative customer journeys and campaigns on the other side, especially since the foundation of marketing theory and practice should be to establish a satisfying consumer experience (Larsen & Wright, 2020). Additionally, user experience data collected in the field and a retail setting is scarce (Feil-Seifer et al., 2020) and can give new insights into the understanding of consumers and the further development of robot features.

This study will investigate the relationship between age and consumer experiences. Therefore, data on HRI and customer experience is collected from 40 shopping mall customers over a period of seven days within seven weeks. The data is then used in statistical analysis to test the interactions between age and consumer experiences.

LITERATURE REVIEW

User Experience in Human-Robot Interactions

Human-robot interactions as an area of interest are continually gaining traction and are characterized by their high degree of interdisciplinarity (Salem et al., 2015). It incorporates scientific insights from fields like robotics, engineering, computer science, psychology, linguistics, and ethology (Dautenhahn, 2007). As the term suggests, HRI research focuses heavily on the interplay between robots and people, which is different from traditional robotics research (Dautenhahn, 2007). Despite the obvious importance of the human factor within HRI, the term user experience is traditionally associated by practitioners and researchers with classic human-computer interactions (Hassenzahl & Tractinsky, 2006). Nonetheless, user experience in HRI has received more attention in recent years and is considered very important for future research, so this could change (Alenljung et al., 2017). This shift in attention is necessary because otherwise, it will be difficult to account for the fact that users perceive robots differently than other technologies, largely due to their much closer resemblance to human appearance (Weiss et al., 2011). This is why de Graaf and Allouch (2013) investigated which variables influence the acceptance and therefore also user experience of the interaction with social robots. Social robots can be defined by their ability to communicate with consumers, their autonomous decision making and their ability to create relationships through their appearance (Roozen et al., 2023). The proposed variables related to the social robot itself, the users themselves, and the users' perception of the possible interaction and the therein included role of hedonism and pragmatism (de Graaf & Ben Allouch, 2013). An early author dividing user experience into hedonic and pragmatic values is Hassenzahl (Hassenzahl, 2008; Hassenzahl et al., 2000), who contributed on the general idea of user experience, be it in HRI or human-computer interactions (HCI). Hedonism refers to qualities that have no direct relations to the task such as originality, innovativeness and beauty (Hassenzahl et al., 2000). In a study from 2014, Barnett et. al (2014) investigated which expectations users have towards social robots and found a paradoxical situation: The participants expected the robot to act

machinelike regarding speed and precision, but also to show human characteristics like empathy.

The related work mentioned above demonstrates the complexity of the topic and the range of use cases. To better understand these possible applications, the following section presents the state of research in the most relevant area for this study: the service sector.

Human-Robot Interactions in Service Domains

One of the most prevalent HRI research settings is in the healthcare domain (Weiss & Bartneck, 2015). However, there are some studies that examine HRI in other service domains, to which retail can also be associated. The following section will provide an overview of some of these studies.

Since the service domain is a broad field, there are various possibilities for the use of robots. For example, Tuomi et al. (2021), Lu et al. (2021), Choi et al. (2021) and Mende et al. (2019) observed HRI in a restaurant service setting and gained interesting insights such as that a humanlike voice has a positive impact on service evaluation (Lu et al., 2021).

Recently researchers have also begun to investigate HRI in retail settings. For example, Vaziri et al. (2020) investigated human-robot collaboration in a pharmacy and designed a remote working environment to gain new insights about possible work conditions and environments in the future. Research has also produced new knowledge on HRI in a shopping mall setting, which, as mentioned earlier, is also the research context of this study. It has been found that the ability of robots to be entertaining and useful facilitates the adoption of technology (Niemelä et al., 2019) and that the three factors of pointing gestures, the appropriate use of landmarks and the estimation of the distance to a destination are central for a robot providing guidance within shopping mall (Heikkilä et al., 2019). While these two studies took a qualitative approach, the study by Golchinfar et al. (2022) examined HRI in a shopping mall in a quantitative manner and concluded that only hedonic qualities significantly contribute to predicting a customer's intention to use a robot and that user experience evaluation in HRI requires further predictive factors. It should be mentioned that all these studies did not focus on age as a determining factor. This of course underlines the importance of better understanding this variable in retail.

Impact of Age on User Experience in Human-Robot Interactions

The focus of this study is to investigate the impact of age on the consumers' user experience and satisfaction with the robot.

Age impacts consumer behavior in different ways, with the intention to provide product feedback being just one example (Manner & Lane, 2018). It is particularly important for the marketing of products and services, as it serves as a differentiator and mediating variable within the target group and in this respect can indicate necessary adjustments in product design and other factors, that lead to a higher acceptance and satisfaction by consumers (Bapat & Kannadhasan, 2022).

One concept that addresses different elements that are important for the adoption of technological products is the technology acceptance model, which hypothesizes perceived usefulness and perceived ease of use to be fundamental for user acceptance (Davis, 1989). A relatively recent meta-analysis investigated the relationship between age and technology acceptance (Hauk et al., 2018). The study found, that age is negatively related to technology acceptance, especially to perceived ease of use. This negative relationship was particularly evident in growth and knowledge-related technologies. In addition to these broader findings, the literature review revealed that the few studies that examine the impact of age on user experience in HCI and HRI reach conclusions that are in some cases contradictory.

In a comparatively early article, Czaja and Sharit (1998) investigated the impact of age on attitudes towards computers. They found that there are no significant age differences in overall attitudes towards computers.

Another study from the field of HCI comes to similar results. Bobeth et al.(2014) investigated the influence of age on the user experience of different control options of multimedia applications and found no significant effect.

However, there are also counterexamples in the field of HCI like the study of Mkpojiogu et al. (2019). Here the authors found, that age has a significant influence on the perceived satisfaction and usability of different mobile banking apps. These studies show, that there are mixed results regarding the topic in the field of HCI.

The same is true for the area of HRI. Kuo et al. (2009) examined the role of age and gender in user acceptance of healthcare robots. They found no significant differences between the age groups. Roozen et al. (2023) came to similar conclusions and found that age had no significant effect on the perception of service quality in HRI. However, Strait et al. (2015) found contradictory results, with their first experiment showing no significant influence of age, but the second finding a significant impact of age on the perception of the robot. This impact refers to the variables 'comfort with the robot' and 'perception of the robot as controlling'.

It becomes apparent, that the results regarding age in HRI are not consistent. Of course, it has to be said that the studies from the field of HCI listed above can only be transferred to HRI to a limited extent. Furthermore, the factors investigated by the authors differed, ranging from attitudes towards computers or user experience to usability and the perception of service quality with robots. Nevertheless, the literature review shows that there is no clear picture of the impact of age on HRI and that this gap in the current state of research needs to be filled. This unclear state of research prompted our study to take a closer look at the variable of age and its effects.

Wizard of Oz Technique

Developing and successfully integrating a new technology takes a lot of time, especially when dealing with a system as complex as a humanoid robot. This can lead to developers not being able to get user feedback in the early design stages, as most of the robot's functions are not yet mature enough to allow fluid interaction. Thus Kelley (1984) proposed the Wizard of Oz (WoZ) technique, which can be used to reduce the timespan between the development and employment of the robot. WoZ involves an individual, which is called 'wizard', who is able to remotely influence the robot's behavior (Riek, 2012). This can take place in various, not mutually exclusive ways. Golchinfar et al. (2022) describe three possibilities: 1. Only some functions of the robot are controlled by the wizard, while other modules act autonomously; 2. the system acts autonomously and is only controlled by the wizard if a task is too complicated or cannot yet be solved by the system due to its stage of development; 3. all incoming inputs are processed by the wizard, which subsequently creates an output. Some researchers perceive this technique as problematic (Riek, 2012). However, recent research by Nasir et al. (2022) has shown that there is no significant difference in user perception whether the robot is controlled by a wizard or acts autonomously.

STUDY DESIGN

Research Setting

To investigate the user's interaction with the robot in a natural way, it was decided to conduct the study in the form of a field experiment. Besides the obvious advantage of field experiments having a high degree in terms of relevance and transferability to real-life problems, respectively practice in general, this type of research method is of course also accompanied by a loss of control compared to lab experiments (Schram & Ule, 2019). Nevertheless, it was

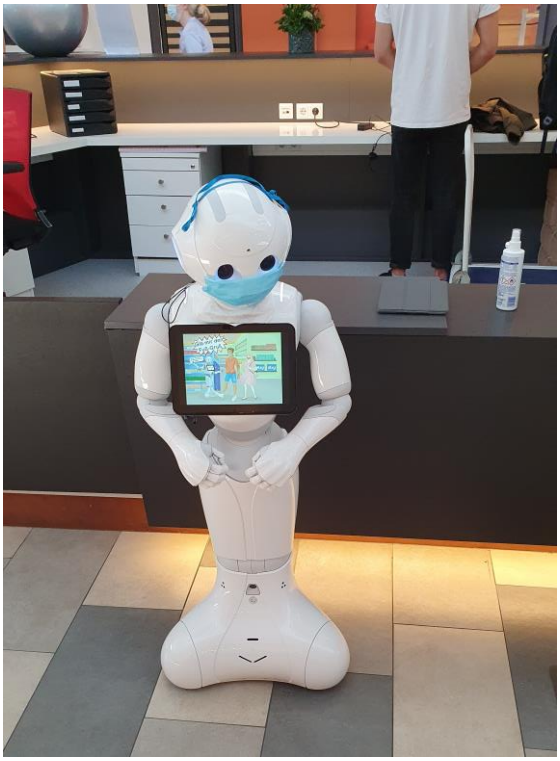
decided to make this trade-off with the clear goal of gaining insight into the actual practicality of HRI in real-world retail settings. In addition, the use of a field experiment contributes to the existing body of knowledge in HRI, as most HRI research uses laboratory and online experiments as the method of choice (Feil-Seifer et al., 2020).

The study is part of a long-term project in cooperation with a mall in the German city Sankt Augustin. We used the humanoid robot model Pepper from Softbank Robotics. Pepper's appearance addresses hedonic and pragmatic qualities and research suggests that the design of the robot leads to a higher attribution of mental capabilities compared to other robot models like the NAO (Manzi et al., 2021). Subsequently, Pepper has a higher potential of being accepted in service-relevant processes than other non-humanoid robots. Pepper has a head module with a human face shape, including eyes, nose and mouth.

The head can be moved from left to right and top down. The head sits on a neck that is connected to a human-like torso. Left and right of the torso Pepper has human-like arms and hands with five fingers respectively. The torso connects to the leg module. Pepper's legs are static and cannot be moved freely. Below the legs, small motor wheels allow free movement of the robot. The overall height of Pepper is 121 cm.

We placed Pepper at the mall service point for two hours per week over a seven-week period during the early stages of the pandemic, resulting in a total of fourteen hours of potential interaction time. These service points are located in the hallways of the shopping mall and are frequently passed by customers to get to the different mall stores. An interaction with the robot and subsequent completion of the questionnaire took an average of ten minutes. Figure 1 illustrates the robot system Pepper at the mall's service point.

Figure 1: Workplace of the Service Robot Pepper Inside the Mall



For most of the interaction, the robot acted autonomously. Only for queries that the system was not yet able to process automatically a human assistant intervened and remotely operated the robot. The wizard was a trained research assistant simulating not-too-human robot

behaviour and responses to avoid bias in the results. This approach was appropriate, as the main focus was to provide a realistic and fluid interaction, which would have been interrupted otherwise.

Research Design

The previously described research setting had an impact on the research design, as it was predetermined and could not be changed as in a laboratory setting. Factors that were influenced the most by this were the sampling method and the frequency of data collection. Since the service point was located in one of the mall's aisles, the sample was limited to visitors who passed by there. Consequently, this study applied convenience sampling to adapt to this environment. In addition, there was no guarantee that enough participants could be persuaded to participate in the study, so a multiple cross-sectional design had to be used. The multiple cross-sectional design approach was appropriate for our study, as the purpose was not to examine a change in user experience but to capture it at any point in time in the form of a 'snapshot' and draw conclusions from it.

Data Collection

Data on the participants' user experiences and corresponding satisfaction were collected using the so-called 'Godspeed Questionnaire'. The framework by Bartneck et al. (2008) was supplemented by a section on demographic factors and questions on the participants' intention to interact with a robot in the future, as well as the importance of the different user experience factors.

Bartneck et al. (2008) introduced the 'Godspeed Questionnaire' with the intention of providing a standardized tool for the evaluation of HRI. They incorporated five factors measuring the user experience of the interaction: anthropomorphism, animacy, likeability, perceived intelligence, and perceived safety. Each of these factors is assessed by multiple semantic differential scales with two bipolar adjectives on each side of the spectrum. The scale is divided into five intermediate levels, with the adjective with a negative connotation at level one and the more positive term at level five. Anthropomorphism for example is evaluated by items like fake on the one hand and natural on the other hand or unconscious – conscious. Likeability, as another example, is measured through terms like unfriendly – friendly or dislike – like. For one of the scales, the terms had to be rearranged to keep this structure consistent from negative to positive (quiescent – surprised). As this evaluation tool is easily transferable and applicable in a real-life scenario and does not require multiple methods for meaningful results, it was particularly suitable for the research setting given in this study. Moreover, a meta-analysis (Weiss & Bartneck, 2015) shows that the 'Godspeed-Questionnaire' is one of the most utilized questionnaires in the area of HRI which speaks for its reputation. It also reveals that the questionnaire is used for a variety of robot models, with the NAO robot being the most common, demonstrating its versatility.

Another reason for the usage of the 'Godspeed-Questionnaire' in this study is the application context of previous studies. To elaborate on this point, we can take the 18 studies from the meta-analysis using the NAO robot as a reference point to ensure comparability. Here most of the studies did not display any specific context (Weiss & Bartneck, 2015). To be more precise nine of the studies examined the NAO robot in a scenario without a particular context (Schillaci et al., 2013; Mohammad & Nishida, 2014; de Graaf & Ben Allouch, 2013; Ham et al., 2011; Joosse et al., 2013; Zlotowski & Bartneck, 2013; Krogsager et al., 2014; van Dijk et al., 2013; Złotowski et al., 2014). The second most common application scenario relates to care for the elderly or care in general (Bruna, 2011; Kim et al., 2013; Torta et al., 2013).

This previous list of research scenarios is probably not exhaustive. Nevertheless, it shows that there are still large gaps in the investigation of user experience in different HRI

application scenarios. As retail could be a promising area for HRI in the future, this study attempts to shed light on some of these dark spots and complement the current literature with insights related to this application scenario.
The data collection process was the same for every participant, starting with the acquisition of partakers, followed by a short introduction to the topic and how the robot operates. Afterwards, the interaction took place and participants were then asked to evaluate the interaction.

The participants' interactions with the service robot varied as there was no defined script. Instead, the participants were informed about the robot's capabilities during the introduction and were then free to interact with it. Following this approach, interactions ranged e.g., from participants asking for the way to a certain store to participants asking where they can buy a particular product. To give the reader a concrete idea of the robot's capabilities, the following is a short example of one of the interactions: A participant told the robot that he would like to buy new shoes and asked which shop in the mall would be suitable for this. The robot answered by giving a list of shops that would be suitable. Then the participant asked for directions, which the system provided.

Other participants held a more casual conversation talking about the current weather or asking the robot to tell a joke.

Research Question and Hypothesis

The literature review revealed various gaps in the current research. This naturally gives rise to many possible research questions, some of which this study attempts to answer by the aforementioned methods.

The literature described earlier shows that the focus of current research is on health scenarios, which are mostly studied in laboratory settings. Furthermore, it becomes apparent that the results regarding the influence of age on HRI have to be described as ambivalent. Subsequently, this exploratory study tries to address this gap in the literature by asking the following research question: How do participants assess their user experience and satisfaction with service robots in settings like a realistic retail scenario and what impact does age have on this assessment?

In addition, an attempt is made to reduce the ambiguity of the findings regarding age and to test the results of Strait et al. (2015) by formulating the hypothesis: There is a significant difference in the evaluation of the interaction in terms of user experience and satisfaction between young and more senior age groups.

RESULTS

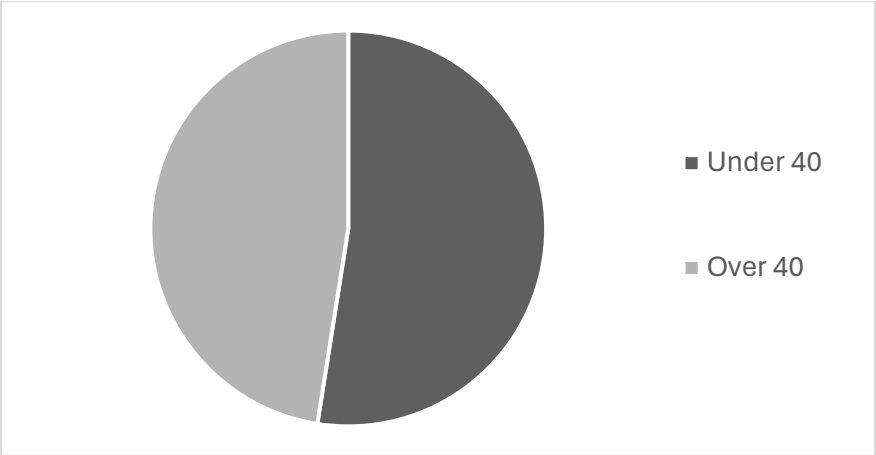
Descriptive Results

During the field experiment period, the user experience data of 40 participants (n=40) was gathered. Of this sample, 55 per cent (n=22) of participants were male and 45 per cent (n=18) were female. None of the respondents stated to belong to the diverse gender group. Thus, the gender distribution can be described as relatively balanced.

In order to be able to test the hypothesis of this study, it was necessary to divide the sample into a young and a more senior age group. This led to the creation of an under-40 age group, which includes arguably more technology-savvy participants. The participants in this group differ from the other age groups in their high level of technology adoption for various technologies (Vogels, 2019). The older age group of over 40s, on the other hand, have not necessarily grown up with sophisticated technology products, leading to a different attitude towards technology and its adoption. This distinction according to technological sophistication is more sensible, rather than an arbitrary division.

As Figure 2 shows, the sample is balanced, with the under-40 age group being slightly larger (n=21) than the more senior group (n=19).

Figure 2: Age Distribution of the Sample



Results Regarding the Participants' Evaluation of User Experience and Satisfaction with the Service Robot

After providing their demographic data, participants were asked to rate their user experience and satisfaction based on the five factors proposed by Bartneck et al. (2008) (Table 1). The category anthropomorphism reached a mean of 3,040 (±.809), which means that the participants had a relatively neutral attitude towards this factor. Animacy was rated similarly with a mean of 3,320 (±.672).

The third factor, called likeability, reached a higher score for user experience with a mean of 4,340 (±.787) and is therefore described satisfactorily by the participants with positively connotated adjectives. The same applies to the factor of perceived intelligence, albeit with a lower mean of 3,845 (±.841). Perceived safety, the final user experience factor rated by participants in this study, was given an average score of 3,816 (±.837), indicating satisfaction with this variable.

After the respondents evaluated the user experience of their interaction with the robot, they were asked to report which of the factors was, in their opinion, the most important for a satisfactory user experience. Here 37,50 per cent (n=15) of the participants chose the factor likeability as the most important one, followed by perceived intelligence with 30 per cent (n=12). Perceived safety and anthropomorphism were reported by 12,50 per cent (n=5) each. The least important factor seems to be animacy, with 7,50 per cent (n=3). Finally, respondents were asked if they could imagine to interact with a robot more often in the future and being advised by it. Here 80 per cent (n=32) chose yes, five per cent (n=2) no and 15 per cent (n=6) said they were undecided.

Results Regarding the Impact of Age on User Experience in HRI

To investigate the question of whether age has an influence on the user experience when interacting with the service robot, it was necessary to conduct statistical tests. As a first step, it was decided to test if there is a significant difference between the consumers coming from the group of under 40-year-olds and the more senior group. For this purpose, a T-test with a confidence interval of 95 per cent was carried out. The test showed that there is a significant difference between the two age groups regarding their evaluation of the user experience with the service robot in a realistic scenario, $t(38) = 2,571$, $p = .014$. The under-40 age group assessed the user experience of the interaction more satisfactorily ($M = 3,900$, $SD = .536$, n =

21) than the participants in the over-40 group (M = 3,421, SD = .641, n = 19). The effect size is r = .384, corresponding to a medium effect.

Table 1: Evaluation of User Experience Factors

User Experience Factor	Mean	Standard Deviation	Cronbach's Alpha
Anthropomorphism	3,040	.809	.796
Animacy	3,320	.672	.771
Likeability	4,340	.787	.929
Perceived Intelligence	3,845	.841	.879
Perceived Safety	3,816	.837	.683

DISCUSSION

Results Regarding the Participants' Evaluation of User Experience with the Service Robot

The results of this study give new insights regarding the user experience of HRI in a realistic context. Calculating the mean value for each of the five user experience factors revealed that, on average, participants tend to assess the interaction with adjectives that have positive connotations. This finding applies to all factors, as the mean value for all of them was above the value of three, indicating a satisfactory experience.

The evaluation answers the first part of the research question and shows that service robots can add value not only in a laboratory environment but also in a realistic retail context. Another indication of this assertion can be found in the participants' willingness to interact with a robot in the future. Here the majority of respondents (80 per cent, n=32) answered, that they would be open to further interchanges with a service robot.

These results are in line with the recent results of the study by Golchinfar et al. (2022). This study examined the interaction in a similar environment and with the same robot model. They also found that participants evaluated the interaction positively, although a different UX measurement tool was used. In addition, as mentioned earlier, they found that only hedonic qualities significantly contribute to predicting a customer's intention to use a robot, which is also consistent with this study's finding that likability is seen as the most important factor in terms of user experience.

However, since most previous HRI studies investigated the interactions without a specific context (de Graaf & Ben Allouch, 2013; Mohammad & Nishida, 2014; Schillaci et al., 2013; Ham et al., 2011; Joosse et al., 2013; Zlotowski & Bartneck, 2013; Krogsager et al., 2014; van Dijk et al., 2013; Złotowski et al., 2014) or in a healthcare scenario (Bruna, 2011; Kim et al., 2013; Torta et al., 2013), it is not possible to compare the results one-to-one, leading to the conclusion that further research needs to be conducted to establish a reliable theory on user experience for HRI contexts.

Results Regarding the Impact of Age on User Experience

The statistical analysis showed a significant difference between the user experience satisfaction rating of consumers belonging to the group of under 40-year-olds and consumers from the more senior age group with a medium effect size, which leads to the verification of the previously established hypothesis. This is in line with the findings of Mkpojiogu et al. (2019) and in parts Strait et al. (2015).

However, the results of this study contradict the two studies from the area of HCI by Czaja and Sharit (1998) and Bobeth et al. (2014). In the area of HRI Kuo et al. (2009) and Roozen et al. (2023) came to similar contradicting results.

It must be said that the studies did not examine the exact same variables or frameworks and used different measurement tools, resulting in a lower degree of comparability.

Nevertheless, this study reveals, that age must be taken into account when designing and marketing service robots to support customers along their customer journeys. According to the results of this study, the integration of service robots into the customer journey works best when the target group is relatively young. More senior audiences may show a higher degree of dissatisfaction and therefore be more reluctant to embrace the technology. Therefore, the use of service robots should be made dependent on the specific use case and the expected target group. This finding contrasts with Hunt's (1991) assertion that dissatisfaction decreases with age, and may be an indication that service robots as a technology may be different. Since many Western societies are ageing, the impact of this demographic factor will be an important building block for technology adoption and satisfaction in the future and therefore for the success or failure of service robots. Further studies are needed here, as the group of older people is currently often overlooked in the study of satisfaction and dissatisfaction and has so far received little attention in research (Meiners et al., 2021).

LIMITATIONS

This study provides some valuable insights regarding the user experience of individuals interacting with a robot in a realistic retail scenario. However, it has to be mentioned that there are a few limitations to the results. Firstly, the sample is relatively small. Therefore, the results should be interpreted with caution and generalizations are difficult to make. Secondly, it must be said that the non-iterative nature of human-robot interactions does not allow participants to have exactly the same comparable experiences. This is especially true for interactions in a real-life scenario, as it is hardly possible to eliminate confounding variables. Thirdly, the circumstances under which the study was conducted must be considered a limiting factor. The study took place in the early days of the Covid-19 pandemic. Thus, it is possible that consumers viewed interactions with a humanoid robot more positively as it did not carry the risk of possible infection.

It also has to be mentioned that the evaluations of user experience could differ in another application scenario. It is conceivable that, for example, the ‘perceived safety’ factor is evaluated differently if the robot has to be used in a more demanding area such as healthcare.

CONCLUSION

Human-robot interaction in retail is receiving more and more attention in the scientific discourse. However, this study has shown that there is still a long way to go: The literature review showed that most research is done in laboratory settings (Feil-Seifer et al., 2020), which calls into question if the results are transferable to real-life scenarios. Furthermore, it became apparent that the impact of age on human-robot interactions is not sufficiently explored yet. Additionally, the studies that investigated this phenomenon come to conflicting results.

This paper has tried to contribute to filling these gaps and has shown that social robots have great potential in realistic retail scenarios. Despite the relatively early development stage of social robots, consumer assessments of user experience were above average for each of the factors. Especially the factors likeability and perceived intelligence were rated well.

With regard to the variable of age, a significant difference was found between younger and older participants in this study. Consequently, developers need to be aware of this fact and pay attention to it when designing the robot, especially when it comes to pragmatic functions. Furthermore, marketers need to keep this factor in mind to create innovative customer journeys

that are truly beneficial to consumers. The variable of age will become even more important in the future as most Western societies age.

Finally, this paper encourages further research on the topic of human-robot interactions in realistic retail scenarios. In addition, the influence of demographic factors, especially age, should be further investigated in order to clarify the partly contradictory results in the current discussion.

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