

Can robots substitute human receptionists?

Results from a field experiment

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Abstract

Hospitality companies are facing personnel shortages and high turnover rates and considering robots to take over tasks. Recent years have seen an increase in the deployment and research on service robots. However, most studies use methods where guests report on hypothetical encounters with service robots. These interactions might not be representative of actual experiences, which is why researchers call for experimental repetitions of their work. Answering these calls, we deployed a robot in a hotel lobby. Participants could choose to interact with either the robot or the human reception staff. We collected data from 166 respondents. Although the experienced social presence was lower for the robot, there was no significant difference in the number of requests solved and the experience of hospitality. Although this is promising, we highlight that currently, reception robots are not able to operate a reception, as certain key tasks have not been automated.

Keywords: hospitality robotics, human-robot interaction, reception robot, field study, service robots, information provision

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I. Introduction

The hospitality industry is facing personnel shortages and turnover rates that are higher than in most industries (Liu Lastres et al., 2023). As a possible solution, companies have started using robots to take over tasks, which could reduce the amount of work required for human employees (Ayyildiz et al., 2022, Webster, 2021). Robots taking over dull, repetitive, routine tasks that would result in more enjoyable jobs that remain for human staff are seen as a viable solution (Tuomi, Tussyadiah, and Stienmetz, 2021; Reis et al., 2020; Garvey et al., 2023; Collins, 2020; Ivanov and Webster, 2019).

In recent years, the use of service robots, defined by the International Federation of Robotics as robots operating outside manufacturing (IFR, 2022), in hotels and restaurants has grown (Kuo et al., 2017). As these robots get deployed more often, they have also become an increasingly popular topic for researchers seeking to find out what the implementation of robots means for hospitality (Ivanov et al., 2019, Reis et al., 2020). A variety of robot types has been introduced in the hospitality industry, which are currently capable of transporting items (Shimmura et al., 2020), vacuuming floors (Hospitality Technology, 2022), (partially) preparing meals (Troitino, 2018), and providing information to guests (Tuomi, Tussyadiah, and Stienmetz, 2021).

This study focuses on robots that exchange information with hotel guests, because it directly touches upon the core of hospitality as an industry built on guest interactions (Pijls et al., 2017). We add to a body of literature focusing on interactions between robotic service agents and untrained users (e.g. guests and consumers) which has been a topic of research in the field of hospitality (Choi et al., 2020, Bowen and Morosan, 2018), as well as in marketing (Crollic et al., 2022) and service research (Choi et al., 2021, Larivière et al., 2017). Our study also relates to recent publications about interactions between guests and conversational AI (Garvey et al., 2023) because service robots can serve as a physical interface for guests to interact with an artificial agent (Cherney, 2024). For this research to be relevant for companies that are considering implementing robots, we want to find out how well robots execute information provision tasks compared to human service agents. This study therefore tries to answer the following research question:

RQ1: Can service robots be used just as effectively as human employees to handle guests' information requests?

Studies deploying robots to operate receptions in hotels have been performed in the past (Pinillos et al., 2016, Ahn et al., 2019, Sadangharn, 2022). These studies focused on the effect that the robot had in the hotel and how guests and employees viewed the robot or on the design of the robot and how this could be improved based on its deployment (Pinillos et al., 2016). To the best of the authors' knowledge, no study has been performed where a robot got deployed in a hotel reception to take over a specific task from employees and where the task execution of the human staff was compared to that of the robot. Hospitality is a service industry centred around experiences and interactivity (Grandey et al., 2005), so it is not only important to see whether guests' requests have been taken care of, but also to get an understanding about what guests experience when interacting with a robot. Therefore, the second research question we try to answer is:

RQ2: How is guests' experience affected when interacting with a robotic instead of a human receptionist for information provision?

This is not the first paper studying how guest rate service interactions performed by either robotic or human service agents. Choi et al. (2020) tried to answer a similar question. However, their experiment let participants reflect on an imagined service interaction with either human or robot service agents executing multiple tasks. This method is not uncommon in hospitality research (Shin and Jeong, 2020, Shan et al., 2024, Tussyadiah and Park, 2018, Belanche et al., 2021, Söderlund, 2022, Kim et al., 2021, Romero and Lado, 2021). It is understandable that hospitality robots

are researched in this way, as it is difficult to test new technologies in an actual hotel. Managers might be reluctant to try robots because if this decreases guest experience, it might be costly for the hotel. Understandably, Choi et al. (2020) and Shin and Jeong (2020) call for research on real-life robots to either confirm or debunk the findings from their imagined scenario studies. Researchers also directly call out for more experimental research in the hospitality context (Fong et al., 2016). With this paper we want to answer to both these calls because as Shan et al. (2024) states about hypothetical human-robot interactions in their discussion: “consumer perceptions may differ significantly in a real-world environment” (Shan et al. (2024), p. 161). This study therefore adopts a method where a service robot is implemented alongside the human reception staff in a hotel lobby. Guests are surveyed after they have interacted with either the robot or the human receptionist. In doing so we can further answer the question whether robots are realistic alternatives to humans for information provision in hotels.

2. Literature review

2.1. Robots in hospitality

First development on robots designed to operate in hotels and restaurants can be found in the 2000s, where early prototypes were presented of robots that could autonomously move through semi-structured spaces (Rañó et al., 2004), or that could set and clear tables (Acosta et al., 2006). The developments of robots capable of taking over tasks in hotels and restaurants has continued gradually since then, with new concepts taking a variety of forms and being introduced into hospitality venues (Hema et al., 2009, Pinillos et al., 2016, Graham, 2018). During the Covid-19 pandemic, the deployment of robots in hotels and restaurants increased. The cause for this was twofold, with robots being able to:

- (1) Provide services to guests without them having to come close to human employees, reducing the risk of contamination (Gralinski and Menachery, 2020).
- (2) Take over work now that the hospitality companies were facing personnel shortages due to layoffs (Tu et al., 2021).

Now that the pandemic has ended, robots seem to have secured a role in hospitality operations, with publications referring to them as “drastically changing the service industry” (Rosete et al., 2020: 1) and transforming the service process in the front line of many organisations (Schepers et al., 2022). The robots that are being deployed do differ from traditional robots that can be seen in manufacturing. The development of sophisticated robot arms executing complex, isolated tasks such as baking an egg (Junge et al., 2020) or autonomously cooking pizzas (Ware, 2021) is still ongoing, but simultaneously, robots with simpler hardware are being developed for commercial purposes. Examples include waiter robots (Shimmura et al., 2020; Nonaka et al., 2020), robots that interact with guests, like Pepper (Tuomi, Tussyadiah, and Hanna, 2021) and Temi (Hung et al., 2021), and vacuum robots like Roomba (Tribelhorn and Dodds, 2007). These robots break with the tradition of robots being expensive tailored solutions and allow hospitality companies to robotise tasks relatively easily. The robots that are being used the most by hospitality companies are interaction robots and transportation robots (Chiang and Trimi, 2020).

The current examples of hospitality robotics can be divided in two categories. The first are capable of more complex tasks such as cooking food items. In this case, they are closed off from guests and sometimes also from employees because untrained users might get injured around them. The second, most used category of robots can operate around guests and employees, because the actions they perform, such as turning their wheels or producing audio or video signals are unlikely to harm humans. Robots that operate in complex spaces where guests and employees also exist, need to have complex sensors that keep them from damaging humans or themselves. This development of hospitality robotics is in line with Moravec’s paradox, which states that in the development of robots, it is much easier to automate abstract reasoning tasks than to automate sensorimotor

tasks (Moravec, 1988, p. 15-16). Most commercial robots can take audio signals as input and provide answers that are comprehensible for human guests, while the only physical actions they are capable of is driving around slowly on wheels.

This study focuses on the second category and on robots that provide information to guests specifically. In hospitality settings, these robots take the inquiries of guests as an input and provide output by either producing sound, images on a screen, gestures, or by guiding guests to certain places by moving there themselves. This choice is made because of the direct contact of the robots with guests. It also relates the topic to studies researching hypothetical human robot interactions as they often centre around conversational interactions.

2.2. Research on interactive hospitality robots

Robots in restaurants and hotels have been researched using various methods. The most straightforward method of understanding how interactions with robots influence guest experience would be to implement a robot in a hospitality venue and study its effect. Shimmura et al. (2020) deployed delivery robots in a restaurant that did not interact with guests and found that monetary turnover increased after the robots were introduced. Quantitatively evaluating direct interactions between guests and robots, however, is challenging as it requires guests to report extensively on their experience right after it. This is a sensitive issue, because approaching guests to fill out a survey or talk with a researcher might reduce their overall experience which is a direct downside for any hotel enabling the research. Studies that have implemented robots in hotel lobbies report on other things. Pinillos et al. (2016) primarily reports on the data that their concierge robot recorded, reporting mainly on how often the robot was used, which is not a perfect reflection of the quality of the interactions or the robot's performance. Ahn et al. (2019) deployed a concierge robot that guests were able to interact with through a tablet, but the paper does not report on guest interactions but rather on the robot design and awareness of the hotel staff of the robot. Sadangharn (2022) deployed a robot in a hotel and had guests, staff members and managers interact with it, but this was done to provide context to participants of a qualitative study about the potential for robots in hotels in general. Tuomi et al. (2021) simulated a restaurant environment where guests ordered food via a Pepper robot and were qualitatively surveyed to evaluate pepper as a service provider. There are also studies that evaluate guest experience with robots in hotels or restaurants indirectly by looking at reviews that guests have posted after a visit (Fuentes-Moraleda et al., 2020).

The most used method of studying robot-guest interactions in hotels, however, is through hypothetical scenario studies, where respondents do not interact with the robot that is being researched. Rather, participants are asked to imagine the interaction, sometimes with the help of a video of the interaction, and then report on it. This method has shed light on various aspects of human-robot interactions. Choi et al. (2020) showed that guests preferred interactions with humans over robots and Hoang and Tran (2022) showed that guests rate rooms that were cleaned by humans as cleaner than rooms that were cleaned by robots. Tussyadiah and Park (2018) and Lin et al. (2022) found that guests would sooner adopt more anthropomorphic robots than less anthropomorphic ones. Kim et al. (2021) showed that guests have a higher preference for robotic service agents during a pandemic, and Zemke et al. (2020) found that people prefer a robot whose design matches its functionality, so a more functional design for simpler tasks and a more human like design for complicated tasks. Shan et al. (2024) found that when a robot produces a service failure, which robot behaviour is more appropriate to solve the failure. Gonzalez-Jimenez and Costa Pinto (2024) showed that adopting inclusive AI increases tipping behaviour in guests. Research on managers showed them more likely to adopt robots when robots have a competitive advantage compared to human employees (Pizam et al., 2022). Research on employees has pointed out that employees are more likely to leave a job because of their fear of robots taking over tasks when they are better informed on robots (Khaliq et al., 2022). With imagined scenarios, interactions (Shan et al., 2024) or even robots (Hoang and Tran, 2022) that don't yet exist can be studied. The downside of these methods, however, is that they are not always representative of actual experiences (Eifler and Petzold, 2020). This is also confirmed by Choi et al. (2020), Shan et al. (2024) and Hoang and Tran (2022) themselves,

who point out that their methods only generate hypothetical findings and that field tests with service robots could significantly add to the human robot interaction knowledge. Chan and Tung (2019) also state that explaining an interaction to participants using videos is might not be representative of actual situations where guests experience robots.

The increase in hypothetical studies on the topic of robots could result in ambiguity about what robots are capable of. Studies sometimes claim things that might not be true but that do solidify the subject of robotics as important to research. Van Doorn et al. (2017) have forecasted that in 2025, numerous service experiences will feature technology, which does not get backed up by calculations or statistics. Bowen and Morosan (2018) also claimed that by 2030, 25% of the workforce in hospitality will consist of robots without backing this up, and McCartney and McCartney (2020) stated that service robots have already largely replaced humans in a range of tasks. They back this up by referring to Decker et al. (2017), a source that merely discusses the possible advantages robots could hold. Stating that robots are able to take over any task is also implied in scenario-based studies, where participants are asked to imagine an interaction which might never take place in the way participants envision it. This optimistic belief about robots being able to take over any task, has not been proven and does not even hold true in manufacturing, an industry in which robots have been operating for decades (Benmelech and Zator, 2022). The reality is that robots have been shown to be able to take over certain specific tasks in specific contexts, which might prove useful given current staff shortages of hotels and restaurants. There is little knowledge of how robots affect guest experience, so interactions between humans and robots should be studied in real life experiments. To say something substantial about the potential of robots as alternatives for human service agents, these interactions should be compared to human interactions. In doing so, we can make better judgements on when and how to implement robots.

2.3. Evaluating human-robot interactions

Interactions between humans differ fundamentally from interactions between a human and a robot. Obtaining information from a robot can happen in several ways. Robot interfaces can range from a menu like that of a computer where guests click through menus to receive information to an interface where guests ask the robot a question and the robots reads the resulting answers out loud. Even though the presentation of the requested information can get close to that of a human service employee, the overall design of service robots is often not meant to fully replicate a human. This is because of the uncanny valley theory (Mori et al., 2012) which states that as robots become almost human-like, they will start to induce feelings of eeriness in humans. We expect the way of extracting information from a robot to be different than from a human. When two humans interact, there are natural checks in place where a guest might explain that his question hasn't been fully answered or he or she would like some additional information. Also, the accuracy of the information the robot provides is limited to its programming. There might always be questions that the programmers did not think to include the answer of. Thus, we hypothesise that:

H1: Information requests will not be successfully completed as often by a robot compared to a human receptionist.

Due to deliberate design choices of the robot behaviour and appearance to make it not mimic human beings, as well as the relatively unsophisticated interactions, the social presence that people experience when interacting with a service agent has been shown to be lower when people interact with a robot (Odekerken-Schröder et al., 2021). We therefore hypothesise that:

H2: Guests will experience a lower social presence when interacting with robots than when interacting with human service providers.

Social presence does not cover everything guests experience while trying to obtain information in a hotel. It is possible to imagine a guest preferring to look up information on their smart phone instead of consulting an

employee. Consulting a robot could be more enjoyable for someone with such a preference, even though there is a lower social presence. Research has also pointed out that for certain hypothetical embarrassing information requests, people prefer interacting with robots over humans (Pitardi et al., 2021). A scale to measure guests' experience of hospitality has been developed by Pijls et al. (2017) that consists of 13 items, splitting up the experience of hospitality into the three categories: Inviting, Care and Comfort. *Inviting* here refers to guests experiencing openness and freedom (Pijls et al., 2017). This feeling might be invoked by the surroundings and atmosphere, but it can certainly be enhanced by service employees' behaviour towards guests. Therefore:

H3.1: Information provision interactions with robots will be rated less inviting by guests than interactions with humans.

Care refers to servitude, empathy, and acknowledgement. This sub constructs relates to the human factor of making guests feel at ease and we assume that this part of the experience of hospitality will be reduced when interacting with a service robot. Hence:

H3.2: Because of the lower versatility of the robotic service agent, guests will feel cared for less when interacting with a robot.

Comfort refers to feeling at ease, relaxed and comfortable. This is something service employees can attribute to, but guests might also be perfectly comfortable and at ease with not interacting with service employees (Pitardi et al., 2021). Therefore, we hypothesise that:

H3.3: Guests will not feel less comfortable when interacting with the robotic service agent.

3. Methodology

3.1. Experiment design

The experiment took place in the hotel lobby of a hotel in Amsterdam. A Temi robot (Hung et al., 2021) was installed alongside the human staffed reception for two weeks where it provided visitors with information about the hotel and the city of Amsterdam. The setup is presented in Figure 1. Guests were given a choice to interact with either the robot or the conventional human receptionist. After an interaction, guests were approached by one of the students assisting the researcher in collecting data and asked to fill out a survey, reporting on their interaction. This first required the guests to fill out a consent form, giving the researchers consent to use their anonymised data, after which they proceeded to the main questionnaire. The questionnaire was approved by the ethics committee of the Hotelschool The Hague.



Figure 1. The Temi robot used in the experiment (Source: The Author)

3.2. Measures

To test whether information requests were resolved, we asked guests to report if their request had been taken care of and whether they required additional information. To measure Social Presence, we took items from the 5 item scale by Gefen and Straub (2004). To measure the hospitality experience, we used the scale by Pijls et al. (2017) and adapted the phrasing of the items, after consulting the author, to apply to individual interactions instead of entire hospitality venues. The sub constructs, Inviting, Care and Comfort, consist of 3, 7 and 3 items respectively (Pijls et al., 2017). Alongside the constructs, we also recorded demographics age and gender.

3.3. Data analysis

To test whether the type of service agent affects how often information requests were solved or additional information was needed, Chi-square tests were used. For the rest of the analysis, exploratory factor analysis was used to distinguish the different constructs. To test for significance between the robotic and human receptionist, independent sample t-tests were performed. Previous studies have adopted ANOVA tests for these types of means comparisons (Choi et al., 2020, Lin et al., 2022), but when two groups are studied, t-tests are preferred.

4. Results

4.1. Sample characteristics

201 participants filled out the surveys. After removing the data points of participants who had failed to fill out the survey completely and removing participants under 18, a final sample of 166 participants was reached, from which 94 interacted with a human receptionist, and 72 interacted with the robot. Demographics of the response group can be seen in Table 1.

Table 1. Demographics of the respondents (n=166)

	Frequency	Percentage
<i>Gender</i>		
Female	92	55%
Male	68	41%
Other	6	4%
<i>Age</i>		
18-24	114	67%
25-34	36	22%
35-44	10	6.0%
Over 44	6	3.6%
<i>Service Agent</i>		
Robot	72	43%
Human	94	57%

4.2. Requests solved and additional information required

Table 2 shows how often the requests were solved and how often guests needed additional information from the service agent. In the robotic condition, 64 of the 72 (89%) of respondents got their request solved, compared to 84 of the 94 (89%) in the human condition. A Chi-square test points out that this difference is not significant ($\chi^2 = <0.001$, $p = 1.00$). In the robotic condition, 54 participants (75%) reported that they did not need any further information, compared to 75 (80%) in the human condition. A Chi-square test here also points out that this difference is not significant ($\chi^2 = 0.298$, $p = 0.585$). These results lead us to reject hypothesis H1.

4.3. Social presence and experience of hospitality

The social presence's Cronbach Alpha was 0.948, showing sufficient reliability. Figure 2 shows the distributions of the social presence scores for the human and robot group. The two paired t-test points out that social presence experienced is significantly lower for the robot ($t=4.37$, $p=0.0000264$), leading us to accept

hypothesis H2. For the three subconstructs of the experience of hospitality scale, Cronbach alpha values are all over 0.7 for each construct (*Inviting*: $\alpha=0.862$, *Care*: $\alpha=0.917$, *Comfort*: $\alpha=0.834$), showing sufficient reliability. The distributions for the sub constructs' scores can be seen in Figure 3. Neither of the subconstructs did differ significantly between service agents (*Inviting*: $t=1.62$, $p=0.108$; *Care*: $t=1.22$, $p=0.264$; *Comfort*: $t=0.936$, $p=0.351$). This leads us to reject hypothesis H3.1 and H3.2 and accept hypothesis H3.3.

Table 2. Results: information requests solved and additional information needed

	Requests solved	Request not solved	Additional information needed	No additional information needed
Agent				
Robot	64	8	18	54
Human	84	10	19	75
Chi-square				
χ^2	< 0.001		0.298	
p-value	1.00		0.585	

Table 3. Reliability, means and t-test results for each construct and statement

Construct	Cronbach Alpha	Item	Mean human	Mean robot	t-value	p-value
<i>Inviting</i>	0.862		5.13	4.48	1.62	0.108
		1: The interaction felt inviting	4.99	4.86	0.612	0.542
		2: I experienced openness during the interaction	5.16	4.82	1.69	0.0925
		3: I experienced freedom during the interaction	5.26	4.85	2.00	0.0475
<i>Care</i>	0.917		5.19	5.03	1.12	0.264
		1: I experienced support during the interaction	5.06	5.1	-0.173	0.836
		2: I experienced involvement during the interaction	5.18	5.01	0.922	0.358
		3: I felt treated like a V.I.P. during the interaction	4.45	4.53	-0.321	0.749
		4: The Temi robot/reception employee did its best to take care of me	5.26	5.17	0.433	0.666
		5: The Temi robot/reception employee relieves me of tasks or worries	5.16	4.47	3.41	<0.001
		6: The Temi robot/reception employee is interested in me	5.07	4.74	1.57	0.118
<i>Comfort</i>	0.835	7: I felt important during the interaction	5.03	4.85	0.864	0.389
			5.03	4.48	0.936	0.351
		1: I felt at ease during the interaction	4.88	4.81	0.387	0.700
		2: I felt comfortable during the interaction	5.43	5.03	2.05	0.0420
<i>Social Presence</i>	0.948	3: I felt relaxed during the interaction	5.26	5.25	0.0271	0.978
			5.16	4.29	4.37	<0.001
		1: I experienced a sense of social contact during the interaction	5.24	4.26	4.42	<0.001
		2: I experienced a sense of personalness during the interaction	5.31	4.26	4.70	<0.001
		3: I experienced a sense of sociability during the interaction	5.20	4.47	3.39	<0.001
		4: I experienced a sense of warmth during the interaction	5.10	4.35	3.28	0.00140
		5: I experienced a sense of sensitivity during the interaction	4.97	4.11	3.94	<0.001

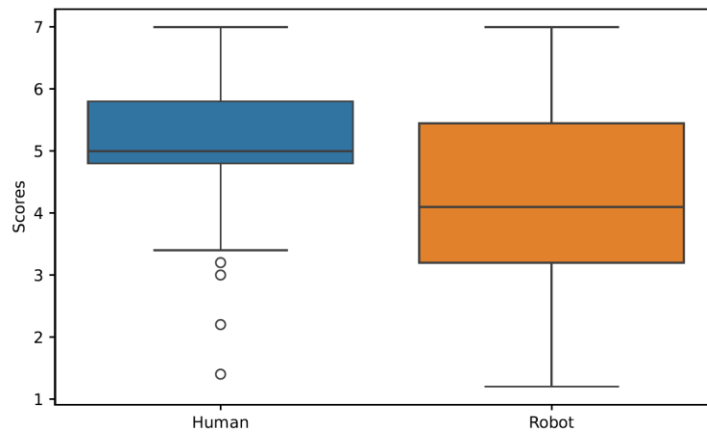


Figure 2. Means distributions of the social presence scores

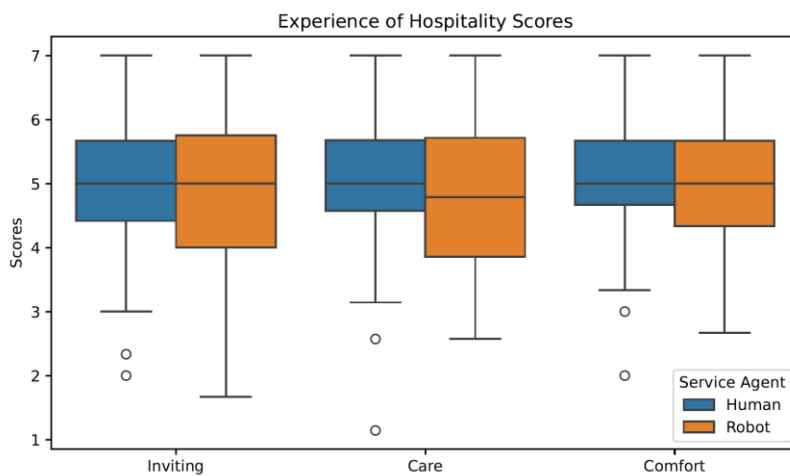


Figure 3. Mean distributions of the experience of hospitality scores

5. Discussion and Conclusion

5.1. Theoretical implications

Results point out that information requests by guests were successfully taken care of by the robot just as often as by the human service employees. There was also no significant difference in the number of times the guest required additional information. This means that RQ1 can be answered with a yes for our situation. This contradicts existing literature, in particular Choi et al. (2020) who noted that guests expect robots to be less knowledgeable than humans in imagined interactions; so in this case, the real situation differs from the hypothetical one. Findings also show that guests experience a lower social presence when interacting with robots, which is in accordance with experimental research on restaurant robots by Odekerken-Schröder et al. (2021). At the same time, the hospitality experience does not change significantly between the human and the robot condition for each of the three subconstructs. We can therefore answer RQ2 by stating that for our case, interacting with robotic receptionists instead of human ones, a lower social presence is experienced, but guests do not feel less invited, cared for or comfortable. These results also contradict findings from recent studies about rating the experience of hypothetical interactions with robotic agents from Choi et al. (2020) and Hoang and Tran (2022). Due to rejecting Hypotheses H1, H3.1 and H3.2, our findings also underpin the fact that

interactions with robots that have been implemented in a real hotel setting may differ from interactions that are imagined. It should however be repeated that, to keep operations in the hotel as natural as possible, our participants could choose with which service agent to interact, and our results therefore only relate to situations where guests are free to choose between a human and a robotic service agent. Our findings might also be subject to a novelty effect, the phenomenon where new prototypes receive increased attention and positive evaluation due to them being new (Koch et al., 2018, Reimann et al., 2023). Because our data collection only spanned two weeks, the experience with the service robots might have been higher than it would be after the novelty has worn off.

This leads us to conclude that in a hotel reception where both humans and robots are present to handle information requests and guests are free to choose, both service agents can handle information provision tasks and contribute to an equally good hospitality experience.

5.2. Practical implications

On a practical level, our findings lead us to conclude that robots can complete information provision tasks just as well as human employees. There was no significant difference in how often guest did not receive the information they requested and in how often the guests required additional information. As for the hospitality experience, there was also no difference on any of the three subconstructs. Guests feel just as invited, comfortable or cared for when receiving information from a robot as from a human. A practical conclusion is therefore that robots like Temi can handle information requests just as well as human receptionists when installed alongside them. At the same time, the robot proved much less versatile than human employees, as the tasks it takes over are limited. Robots get designed to take over tasks, not jobs (Ivanov et al., 2022). This means that deploying a robot for a single task would only work in a hotel where there is enough of that task for a robot to do. Programming a robot also requires a time investment. An assisting student spent several days getting acquainted with the software, programming in all the relevant information and cross checking with reception which information was still lacking. Also, in any hotel setting, information about the hotel premises, facilities in the city and public transport schedules change over time and this information needs to be updated from time to time. Managers seeking to use robots for information provision should consider that robots require both an initial and a continuous investment of resources to be able to provide accurate information to guests. In a practical sense, these results are promising for the future roles for robots in hotels and restaurants as suitable replacements of human employees for certain tasks. At the same time, it should be noted that in their current state, reception robots are not able to operate a hotel reception, as several key tasks have not yet been successfully automated. Examples of this are scanning ID cards or passports, handling payment, and handing out room keys. The full takeover of reception tasks by robots requires robotic applications designed specifically for reception tasks that service robots cannot provide as of now.

5.3. Limitations and further research

This study has focused on a hotel reception task being executed by either a human or robotic service agent. As we have argued, in this situation, hotel receptions would always require human workers alongside robotic ones. Therefore, for the successful deployment of robots in hotels, employees should not have a reduced job satisfaction, for this could cause them to leave the company, which would increase the very problems robots are supposed to be able to solve. Khaliq et al. (2022) and Li et al. (2019) have already shown that awareness of robots could increase turnover intention. It is therefore important to also consider employees when researching hospitality robots, which is something our study has not done. This study only considers one hotel located in the Netherlands. It has been shown that different cultures react differently to robots (Lim et al., 2021). The fact that only one hotel was studied also limits our findings from being generalisable across cultures. Finally, because of the novelty effect that robotic interaction cause, it is difficult to say how much of the experience was related to the robot's novelty and whether the experience could drop after guests have interacted with the robot more often.

A longitudinal study could be performed testing robot performance in different points in time to find out how strong the novelty effect is. Also, the robot has been used in this study with one type of programming, while a robot's programming can be adjusted. Different types of robotic behaviour result in different interactions, and therefore experiences with customers, which is also something we recommend future researchers to investigate. We also recommend further broadening the managerial angle, where receptions with information provision technology are studied to gain insight in how much of the human work actually gets taken over to quantify the effect of reception robots.

Data availability

The data used for this paper is publicly available on the Open Science Framework at <https://osf.io/nhcyp/>

References

- Acosta, L., González, E., Rodríguez, J. N., & Hamilton, A. F. (2006). Design and implementation of a service robot for a restaurant. *International Journal of Robotics & Automation*, 21(4), 273. <https://doi.org/10.2316/Journal.206.2006.4.206-2909>
- Ahn, M. S., Sun, D., Chae, H., Yamayoshi, I., & Hong, D. (2019, June). Lessons learned from the development and deployment of a hotel concierge robot to be operated in a real world environment. In *2019 16th international conference on ubiquitous robots (UR)* (pp. 55-60). IEEE. <https://doi.org/10.1109/URAI.2019.8768562>
- Ayyildiz, A. Y., Baykal, M., & Koc, E. (2022). Attitudes of hotel customers towards the use of service robots in hospitality service encounters. *Technology in Society*, 70, 101995. <https://doi.org/10.1016/j.techsoc.2022.101995>
- Belanche, D., Casaló, L. V., & Flavián, C. (2021). Frontline robots in tourism and hospitality: service enhancement or cost reduction?. *Electronic markets*, 31(3), 477-492. <https://doi.org/10.1007/s12525-020-00432-5>
- Benmelech, E., & Zator, M. (2022). *Robots and firm investment* (No. w29676). National Bureau of Economic Research. <https://doi.org/10.3386/w29676>
- Bowen, J., & Morosan, C. (2018). Beware hospitality industry: the robots are coming. *Worldwide Hospitality and Tourism Themes*, 10(6), 726-733. <https://doi.org/10.1108/WHATT-07-2018-0045>
- Chan, A. P. H., & Tung, V. W. S. (2019). Examining the effects of robotic service on brand experience: the moderating role of hotel segment. *Journal of Travel & Tourism Marketing*, 36(4), 458-468. <https://doi.org/10.1080/10548408.2019.1568953>
- Cherney, M. A. (2024). Nvidia adds generative AI to power humanoid robots. *Reuters*. Retrieved June 21, 2024, from <https://www.reuters.com/technology/nvidia-adds-generative-ai-power-humanoid-robots-2024-03-18/>
- Chiang, A. H., & Trimi, S. (2020). Impacts of service robots on service quality. *Service Business*, 14(3), 439-459. <https://doi.org/10.1007/s11628-020-00423-8>
- Choi, S., Mattila, A. S., & Bolton, L. E. (2021). To err is human(-oid): how do consumers react to robot service failure and recovery?. *Journal of Service Research*, 24(3), 354-371. <https://doi.org/10.1177/1094670520978798>
- Choi, Y., Choi, M., Oh, M., & Kim, S. (2020). Service robots in hotels: understanding the service quality perceptions of human-robot interaction. *Journal of Hospitality Marketing & Management*, 29(6), 613-635. <https://doi.org/10.1080/19368623.2020.1703871>
- Collins, G. R. (2020). Improving human-robot interactions in hospitality settings. *International Hospitality Review*, 34(1), 61-79. <https://doi.org/10.1108/IHR-09-2019-0019>
- Crolic, C., Thomaz, F., Hadi, R., & Stephen, A. T. (2022). Blame the bot: Anthropomorphism and anger in customer-chatbot interactions. *Journal of Marketing*, 86(1), 132-148. <https://doi.org/10.1177/00222429211045687>
- Decker, M., Fischer, M., & Ott, I. (2017). Service Robotics and Human Labor: A first technology assessment of substitution and cooperation. *Robotics and Autonomous Systems*, 87, 348-354. <https://doi.org/10.1016/j.robot.2016.09.017>
- Eifler, S., & Petzold, K. (2020). Validity aspects of vignette experiments: Expected "what-if" differences between reports of behavioral intentions and actual behavior. In Lavrakas, P., Traugott, M., Kennedy, C., Holbrook, A., de Leeuw, E., and West, D. (Eds.) *Experimental methods in survey research: Techniques that combine random sampling with random assignment* (pp. 393-416). John Wiley & Sons. <https://doi.org/10.1002/9781119083771.ch20>
- Fong, L. H. N., Law, R., Tang, C. M. F., & Yap, M. H. T. (2016). Experimental research in hospitality and tourism: A critical review. *International Journal of Contemporary Hospitality Management*, 28(2), 246-266. <https://doi.org/10.1108/IJCHM-10-2014-0506>
- Fuentes-Moraleda, L., Díaz-Pérez, P., Orea-Giner, A., Muñoz-Mazón, A., & Villacé-Molinero, T. (2020). Interaction between hotel service robots and humans: A hotel-specific Service Robot Acceptance Model (sRAM). *Tourism Management Perspectives*, 36, 100751. <https://doi.org/10.1016/j.tmp.2020.100751>
- Garvey, A. M., Kim, T., & Duhachek, A. (2023). Bad news? Send an AI. Good news? Send a human. *Journal of Marketing*, 87(1), 10-25. <https://doi.org/10.1177/00222429211066972>
- Gefen, D., & Straub, D. W. (2004). Consumer trust in B2C e-Commerce and the importance of social presence: experiments in e-Products and e-Services. *Omega*, 32(6), 407-424. <https://doi.org/10.1016/j.omega.2004.01.006>
- Gonzalez-Jimenez, H., & Costa Pinto, D. (2024). Can AI robots foster social inclusion? Exploring the role of immersive augmentation in hospitality. *International Journal of Contemporary Hospitality Management*, 36(11), 3889-3905. <https://doi.org/10.1108/IJCHM-09-2023-1459>

- Graham, J. (2018). Hamburger-making robot flippy is back at Calif. chain. *USA Today*. Retrieved July 3, 2024, from <https://eu.usatoday.com/story/tech/talkingtech/2018/05/28/hamburger-making-robot-flippy-back-serving-300-burgers-day/649370002/>
- Gralinski, L. E., & Menachery, V. D. (2020). Return of the coronavirus: 2019-ncov. *Viruses*, 12 (2), 135. <https://doi.org/10.3390/v12020135>
- Grandey, A. A., Fisk, G. M., Mattila, A. S., Jansen, K. J., & Sideman, L. A. (2005). Is "service with a smile" enough? Authenticity of positive displays during service encounters. *Organizational behavior and human decision processes*, 96(1), 38-55. <https://doi.org/10.1016/j.obhdp.2004.08.002>
- Hema, C. R., Kiang, L. C., & Lot, V. T. S. (2009, March). Housekeeping robot: From concept to design. In *2009 5th International Colloquium on Signal Processing & Its Applications* (pp. 52-54). IEEE. <https://doi.org/10.1109/CSPA.2009.5069187>
- Hoang, C., & Tran, H. A. (2022). Robot cleaners in tourism venues: The importance of robot-environment fit on consumer evaluation of venue cleanliness. *Tourism Management*, 93, 104611. <https://doi.org/10.1016/j.tourman.2022.104611>
- Hospitality Technology (2022). Case study: The garden city hotel enlists smart robotic vacuum to overcome staffing challenges. Retrieved June 25, 2024, from <https://hospitalitytech.com/case-study-garden-city-hotel-enlists-smart-robotic-vacuum-overcome-staffing-challenges>
- Hung, C. F., Lin, Y., Ciou, H. J., Wang, W. Y., & Chiang, H. H. (2021, September). FoodTemi: The AI-oriented catering service robot. In *2021 IEEE international conference on consumer electronics-Taiwan (ICCE-TW)* (pp. 1-2). IEEE. <https://doi.org/10.1109/ICCE-TW52618.2021.9603096>
- IFR. (2022). Ifr press room sales of robots for the service sector grew by 37% worldwide. Retrieved November 2, 2022, from <https://ifr.org/ifr-press-releases/news/sales-of-robots-for-the-service-sector-grew-by-37-worldwide>
- Ivanov, S., Gretzel, U., Berezina, K., Sigala, M., & Webster, C. (2019). Progress on robotics in hospitality and tourism: a review of the literature. *Journal of Hospitality and Tourism Technology*, 10(4), 489-521. <https://doi.org/10.1108/JHTT-08-2018-0087>
- Ivanov, S., & Webster, C. (2019). What should robots do? A comparative analysis of industry professionals, educators and tourists. In *Information and Communication Technologies in Tourism 2019: Proceedings of the International Conference in Nicosia, Cyprus, January 30–February 1, 2019* (pp. 249-262). Springer International Publishing. https://doi.org/10.1007/978-3-030-05940-8_20
- Ivanov, S., Webster, C., & Berezina, K. (2022). Robotics in tourism and hospitality. *Handbook of e-Tourism*, 1873-1899. https://doi.org/10.1007/978-3-030-48652-5_112
- Junge, K., Hughes, J., Thuruthel, T. G., & Iida, F. (2020). Improving robotic cooking using batch Bayesian optimization. *IEEE Robotics and Automation Letters*, 5(2), 760-765. <https://doi.org/10.1109/LRA.2020.2965418>
- Khaliq, A., Waqas, A., Nisar, Q. A., Haider, S., & Asghar, Z. (2022). Application of AI and robotics in hospitality sector: A resource gain and resource loss perspective. *Technology in Society*, 68, 101807. <https://doi.org/10.1016/j.techsoc.2021.101807>
- Kim, S. S., Kim, J., Badu-Baiden, F., Giroux, M., & Choi, Y. (2021). Preference for robot service or human service in hotels? Impacts of the COVID-19 pandemic. *International Journal of Hospitality Management*, 93, 102795. <https://doi.org/10.1016/j.ijhm.2020.102795>
- Koch, M., von Luck, K., Schwarzer, J., & Draheim, S. (2018). The novelty effect in large display deployments—Experiences and lessons-learned for evaluating prototypes. *Proceedings of 16th European Conference on Computer-Supported Cooperative Work - Exploratory Papers, Reports of the European Society for Socially Embedded Technologies* (ISSN 2510-2591), https://doi.org/10.18420/ecscw2018_3
- Kuo, C. M., Chen, L. C., & Tseng, C. Y. (2017). Investigating an innovative service with hospitality robots. *International Journal of Contemporary Hospitality Management*, 29(5), 1305-1321. <https://doi.org/10.1108/IJCHM-08-2015-0414>
- Larivière, B., Bowen, D., Andreassen, T. W., Kunz, W., Sirianni, N. J., Voss, C., ... & De Keyser, A. (2017). "Service Encounter 2.0": An investigation into the roles of technology, employees and customers. *Journal of Business Research*, 79, 238-246. <https://doi.org/10.1016/j.jbusres.2017.03.008>
- Li, J. J., Bonn, M. A., & Ye, B. H. (2019). Hotel employee's artificial intelligence and robotics awareness and its impact on turnover intention: The moderating roles of perceived organizational support and competitive psychological climate. *Tourism Management*, 73, 172-181. <https://doi.org/10.1016/j.tourman.2019.02.006>
- Lim, V., Rooksby, M., & Cross, E. S. (2021). Social robots on a global stage: establishing a role for culture during human–robot interaction. *International Journal of Social Robotics*, 13(6), 1307-1333. <https://doi.org/10.1007/s12369-020-00710-4>
- Lin, M., Cui, X., Wang, J., Wu, G., & Lin, J. (2022). Promoters or inhibitors? Role of task type on the effect of humanoid service robots on consumers' use intention. *Journal of Hospitality Marketing & Management*, 31(6), 710-729. <https://doi.org/10.1080/19368623.2022.2062693>
- Liu-Lastres, B., Wen, H., & Huang, W. J. (2023). A reflection on the Great Resignation in the hospitality and tourism industry. *International Journal of Contemporary Hospitality Management*, 35(1), 235-249. <https://doi.org/10.1108/IJCHM-05-2022-0551>
- McCartney, G., & McCartney, A. (2020). Rise of the machines: towards a conceptual service-robot research framework for the hospitality and tourism industry. *International Journal of Contemporary Hospitality Management*, 32(12), 3835-3851. <https://doi.org/10.1108/IJCHM-05-2020-0450>
- Moravec, H. (1988). *Mind children: The future of robot and human intelligence*. Harvard University Press.
- Mori, M., MacDorman, K. F., & Kageki, N. (2012). The uncanny valley [from the field]. *IEEE Robotics & automation magazine*, 19(2), 98-100. <https://doi.org/10.1109/MRA.2012.2192811>
- Nonaka, T., Shimmura, T., & Fujii, N. (2020). Service system design considering employee satisfaction through introducing service robots. In *Advances in Production Management Systems. Towards Smart and Digital Manufacturing: IFIP WG 5.7 International Conference, APMS 2020, Novi Sad, Serbia, August 30–September 3, 2020, Proceedings, Part II* (pp. 686-692). Springer International Publishing. https://doi.org/10.1007/978-3-030-57997-5_79

- Odekerken-Schröder, G., Mennens, K., Steins, M., & Mahr, D. (2021). The service triad: an empirical study of service robots, customers and frontline employees. *Journal of Service Management*, 33(2), 246-292. <https://doi.org/10.1108/JOSM-10-2020-0372>
- Pijls, R., Groen, B. H., Galetzka, M., & Pruyn, A. T. (2017). Measuring the experience of hospitality: Scale development and validation. *International Journal of Hospitality Management*, 67, 125-133. <https://doi.org/10.1016/j.ijhm.2017.07.008>
- Pinillos, R., Marcos, S., Feliz, R., Zalama, E., & Gómez-García-Bermejo, J. (2016). Long-term assessment of a service robot in a hotel environment. *Robotics and Autonomous Systems*, 79, 40-57. <https://doi.org/10.1016/j.robot.2016.01.014>
- Pitardi, V., Wirtz, J., Paluch, S., & Kunz, W. H. (2022). Service robots, agency and embarrassing service encounters. *Journal of Service Management*, 33(2), 389-414. <https://doi.org/10.1108/JOSM-12-2020-0435>
- Pizam, A., Ozturk, A. B., Balderas-Cejudo, A., Buhalis, D., Fuchs, G., Hara, T., ... & Chaulagain, S. (2022). Factors affecting hotel managers' intentions to adopt robotic technologies: A global study. *International Journal of Hospitality Management*, 102, 103139. <https://doi.org/10.1016/j.ijhm.2022.103139>
- Rañó, I., Raducanu, B., & Subramanian, S. (2004). Human presence detection and tracking for a concierge robot. *IFAC Proceedings Volumes*, 37(8), 986-991. [https://doi.org/10.1016/S1474-6670\(17\)32109-2](https://doi.org/10.1016/S1474-6670(17)32109-2)
- Reimann, M., van de Graaf, J., van Gulik, N., Van De Sanden, S., Verhagen, T., & Hindriks, K. (2023, December). Social robots in the wild and the novelty effect. In *International Conference on Social Robotics* (pp. 38-48). Singapore: Springer Nature Singapore. https://doi.org/10.1007/978-981-99-8718-4_4
- Reis, J., Melão, N., Salvadorinho, J., Soares, B., & Rosete, A. (2020). Service robots in the hospitality industry: The case of Henn-na hotel, Japan. *Technology in Society*, 63, 101423. <https://doi.org/10.1016/j.techsoc.2020.101423>
- Romero, J., & Lado, N. (2021). Service robots and COVID-19: exploring perceptions of prevention efficacy at hotels in generation Z. *International Journal of Contemporary Hospitality Management*, 33(11), 4057-4078. <https://doi.org/10.1108/IJCHM-10-2020-1214>
- Rosete, A., Soares, B., Salvadorinho, J., Reis, J., & Amorim, M. (2020). Service robots in the hospitality industry: An exploratory literature review. In *Exploring Service Science: 10th International Conference, IESS 2020, Porto, Portugal, February 5-7, 2020, Proceedings 10* (pp. 174-186). Springer International Publishing. https://doi.org/10.1007/978-3-030-38724-2_13
- Sadangharn, P. (2022). A multidimensional analysis of robotic deployment in thai hotels. *International Journal of Social Robotics*, 14(4), 859-873. <https://doi.org/10.1007/s12369-021-00833-2>
- Schepers, J., Belanche, D., Casaló, L. V., & Flavián, C. (2022). How smart should a service robot be?. *Journal of Service Research*, 25(4), 565-582. <https://doi.org/10.1177/10946705221107704>
- Shan, M., Zhu, Z., Chen, H., & Sun, S. (2024). Service robot's responses in service recovery and service evaluation: The moderating role of robots' social perception. *Journal of Hospitality Marketing & Management*, 33(2), 145-168. <https://doi.org/10.1080/19368623.2023.2246456>
- Shimmura, T., Ichikari, R., Okuma, T., Ito, H., Okada, K., & Nonaka, T. (2020). Service robot introduction to a restaurant enhances both labor productivity and service quality. *Procedia CIRP*, 88, 589-594. <https://doi.org/10.1016/j.procir.2020.05.103>
- Shin, H. H., & Jeong, M. (2020). Guests' perceptions of robot concierge and their adoption intentions. *International Journal of Contemporary Hospitality Management*, 32(8), 2613-2633. <https://doi.org/10.1108/IJCHM-09-2019-0798>
- Söderlund, M. (2022). When service robots look at themselves in the mirror: An examination of the effects of perceptions of robotic self-recognition. *Journal of Retailing and Consumer Services*, 64, 102820. <https://doi.org/10.1016/j.jretconser.2021.102820>
- Tribelhorn, B., & Dodds, Z. (2007, April). Evaluating the Roomba: A low-cost, ubiquitous platform for robotics research and education. In *Proceedings 2007 IEEE International Conference on Robotics and Automation* (pp. 1393-1399). IEEE. <https://doi.org/10.1109/ROBOT.2007.363179>
- Troitino, C. (2018). Meet the world's first fully automated burger robot: Creator debuts the big mac killer. Retrieved March 31, 2022, from <https://www.forbes.com/sites/christinatroitino/2018/06/21/meet-the-worlds-first-fully-automated-burger-robot-creator-debuts-the-big-mac-killer/?sh=4187c4766a89>
- Tu, Y., Li, D., & Wang, H. J. (2021). COVID-19-induced layoff, survivors' COVID-19-related stress and performance in hospitality industry: The moderating role of social support. *International Journal of Hospitality Management*, 95, 102912. <https://doi.org/10.1016/j.ijhm.2021.102912>
- Tuomi, A., Tussyadiah, I. P., & Hanna, P. (2021). Spicing up hospitality service encounters: the case of Pepper™. *International Journal of Contemporary Hospitality Management*, 33(11), 3906-3925. <https://doi.org/10.1108/IJCHM-07-2020-0739>
- Tuomi, A., Tussyadiah, I. P., & Stienmetz, J. (2021). Applications and implications of service robots in hospitality. *Cornell Hospitality Quarterly*, 62(2), 232-247. <https://doi.org/10.1177/1938965520923961>
- Tussyadiah, I. P., & Park, S. (2018). Consumer evaluation of hotel service robots. In *Information and Communication Technologies in Tourism 2018: Proceedings of the International Conference in Jönköping, Sweden, January 24-26, 2018* (pp. 308-320). Springer International Publishing. https://doi.org/10.1007/978-3-319-72923-7_24
- Van Doorn, J., Mende, M., Noble, S. M., Hulland, J., Ostrom, A. L., Grewal, D., & Petersen, J. A. (2017). Domo arigato Mr. Roboto: Emergence of automated social presence in organizational frontlines and customers' service experiences. *Journal of Service Research*, 20(1), 43-58. <https://doi.org/10.1177/1094670516679272>
- Ware, J. (2021). I visited a Paris pizzeria without any human staffers — here's what it was like to watch robots make my meal. *Business Insider*. Retrieved March 31, 2022, from <https://www.businessinsider.com/pazzi-paris-pizzeria-robot-chefs-menu-what-its-like-2021-1?international=true&r=US&IR=T>
- Webster, C. (2021). Demography as a driver of robonomics. *ROBONOMICS: The Journal of the Automated Economy*, 1, 12. <https://journal.robonomics.science/index.php/rj/article/view/12>
- Zemke, D. M. V., Tang, J., Raab, C., & Kim, J. (2020). How to build a better robot... for quick-service restaurants. *Journal of Hospitality & Tourism Research*, 44(8), 1235-1269. <https://doi.org/10.1177/1096348020946383>