Exploring Customer Experience with Service Robots in Hospitality and Tourism: Activity Theory Perspective

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Abstract. Addressing a call for theoretical development in human-robot interaction research, this study introduces activity theory to the field of service robots (SRs) in hospitality and tourism. Activity theory was used as the foundation for the conceptual analysis of in-depth interviews with hospitality customers. The results of content analysis of the interviews and future research directions are presented based on each of the service activity system's components: object (customer experience (CE) with SRs in a hospitality unit), subject (customers), technology (SRs), rules (implementation procedures of SRs), community (customers, other customers, and employees), division of labor (a division of service), outcome (satisfaction, overall experience with hospitality establishments, and behavioral intentions), and context. The study provides future research directions in using activity theory in studies on human-robot interaction and CE with SRs in hospitality and tourism. Robot developers and hospitality professionals can use the data analysis framework proposed in this study to evaluate CE with SRs.

Keywords: Service robot · Activity theory · Customer experience · Human-robot interaction

1 Introduction

Research on service robots (SRs) in the hospitality and tourism industry has recently received significant attention. However, a need remains for further theoretical development. Jung and Hinds [1] call for creating more human-robot interaction (HRI) theories from the social sciences and interdisciplinary research combining robotics, design, and behavioral sciences. Most theories and conceptual models in HRI in service, hospitality, and tourism focus on robot design, features, functions, and performance when describing customer-robot interaction (e.g., the Service Robot Acceptance Model (sRAM) [2]) or a few aspects, like robot behavior, customer characteristics, and specific context of companies, that influence customer engagement and behavior [3, 4]. But those theories do not look at HRI in service as a whole system that changes during the service and over time. To close this gap, this study introduces activity theory [5–9] to the specific area of hospitality technology and hospitality robotics.

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Activity theory has been frequently used in the fields of human-computer interaction (HCI) and technology design in diverse contexts [5] and service design [10–13]. For instance, activity theory has been deployed to study the design of interactional social robots [14], the concept of robot as a service in cloud computing [15], and the context of robot-assisted special education [16]. However, this is the first study to employ activity theory in the context of SRs in hospitality and tourism.

Activity is the central unit of analysis in activity theory [8]. Activity is described as "purposeful, social, mediated, multilevel, and developing interaction between actors ('subjects') and the objective world ('objects'). A central claim of the approach is that it is an activity that places the subject in objective reality and transforms the reality into a form of subjectivity" [5] (p. 609). The subject can be an individual or a group that participates in an activity and transform the object into outcomes using tools [17]. Both the object and tools can be tangible or intangible. In HCI, a tool is a computer or technology that mediates activity [8].

There are different interpretations and modifications of activity theory [5]. One of the most known and influential versions of activity theory in HCI research was created by Engeström [6, 7]. Engeström [6, 7] proposed activity theory for collective activities and a model for an activity system that includes the following components: subject, object, tools (mediators), rules, community, division of labor, and outcome. Components of activities are different in certain situations and specific contexts [6, 7], and they develop and transform over time [6, 8]. The analysis based on activity theory [6, 7] can help explore customer experience with SRs in the activity system of service in hospitality and tourism.

Customer experience (CE) with SRs is an important but understudied concept in studies about HRI in hospitality. There are many hospitality and tourism businesses that employ SRs. And with the current demographic trend of the aging population, robots will be employed in many services, including hospitality and tourism, and robot service experience will be a norm [18]. Enhancing CE can enhance service value and increase satisfaction, behavior intentions, and loyalty [19]. The service experience can also differentiate the business from its competitors [19].

Despite practical importance, academic literature still lacks in-depth knowledge about CE with SRs in hospitality and tourism. Only three studies explored CE with SRs based on content analysis of customers' online reviews on social media [20–22], and one study with a conceptual model of smart service experience in hospitality and tourism, including experience with SRs [23].

Thus, the aim of this research is: 1) to introduce activity theory to the field of SRs and demonstrate the application of this theory to CE with SRs in hospitality and tourism; and 2) to formulate future research directions for the investigation of HRI and CE with SRs in hospitality and tourism. This is the first study that introduces activity theory to HRI in the hospitality and tourism domain. It uses activity theory as a theoretical foundation for the conceptual analysis of in-depth interviews with hospitality customers from different countries and cultures that describe their experience with SRs in hospitality and tourism establishments. The analysis framework proposed in the study can be used by robot developers and hospitality professionals for the evaluation of CE with SRs. The study

also proposes future research directions for using activity theory in research in the domain of HRI and CE with SRs in hospitality and tourism.

2 Methods

2.1 Interview Operationalization and Sample

Thirteen in-depth interviews were conducted via Zoom with hospitality and tourism customers who had experience with service robots (SRs). To find qualified participants, an online survey was conducted on Prolific to identify those respondents who experienced SRs in hospitality and tourism. Their Prolific IDs were recorded in an Allowlist. Then, the invitation to participate in the interview was sent to qualified respondents from the Allowlist.

The identity of the interviewees was protected, only their demographic information and prolific IDs were recorded. The interviews were audio recorded and transcribed verbatim for further analysis. The interviews included questions about the customer experience (CE) with SRs, their satisfaction with their experience, service delivered by robots, and overall experience in hospitality and tourism establishments.

Residents of seven countries were interviewed. The sample had an almost equal representation of males and females. The average age of the interviewees was 29 years old. Please see the interviewees' profiles for more information.[1]

2.2 Using Activity Theory for Interview Analysis

Interviews were analyzed manually to identify patterns in data to develop themes and concepts that correspond to the study's goal. The data were analyzed using qualitative codes based on activity theory components in the activity system model by Engeström [6, 7]. Engeström's [6, 7] interpretation of activity theory is applicable to the analysis of CE with SRs in the hospitality and tourism environment because the focus of this theory is the activity system. The studies on CE design stated that CE forms an activity system or multiple activity systems [11, 13]. Engeström's [6, 7] activity theory interpretation was also a base for studies in designing robotic service systems [15], learning systems with robots [16], and other technologies [17, 24].

In the context of hospitality robotics and activity theory, the activity may be seen as a service delivery process by robots and human employees that form CE in hospitality and tourism settings. This study adopted the activity theory framework from [6, 7, 16] and adapted it to the study context (See Fig. 1). The elements of the activity system and codes for analysis in this study include subject, object, technology (tools), rules, community, division of labor, outcome, and context.

[1] The table with the interviewees' profiles is available in the supplementary materials at https://drive.google.com/file/d/1WwyJrF0bYYeqJXrFWlC2-MFTkjV0Y-Sx/view?usp=sharing or upon request.

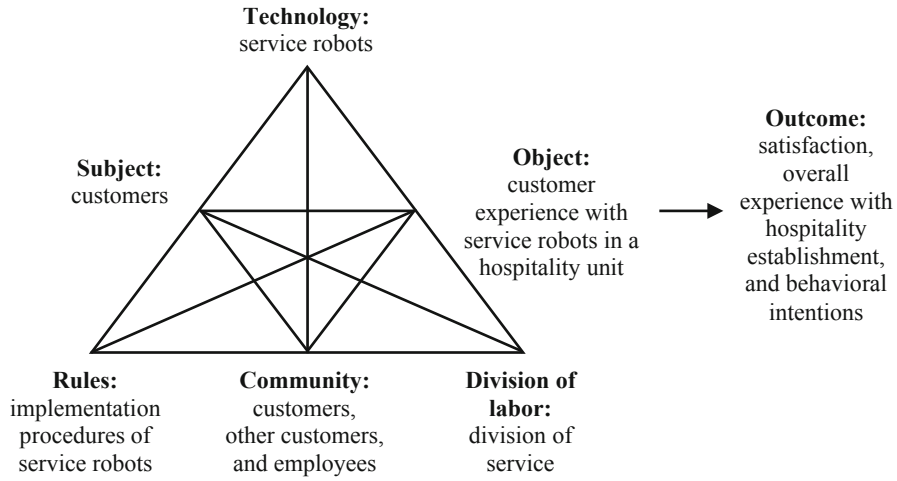

Fig. 1. Activity theory model (adopted from Engeström [6, 7]) for analysis of customer experience with service robots in hospitality and tourism.

The codes for analysis of CE with SRs in hospitality and tourism are described below.

Object includes CE with and an attitude towards SRs in a hospitality unit.

Subject refers to customers that received service from robots.

Technology refers to SRs that deliver service directly with or without the assistance of human employees or in combination with other systems. The robots may have different characteristics, roles, and tasks.

Rules include implementation procedures of SRs.

Community refers to customers, other customers, and employees that participate in service delivery or influence CE.

Division of labor refers to a division of service or, in other words, the separation of the tasks among customers, robots, and employees during service delivered by robots.

Outcomes of service delivery and experience with SRs are satisfaction, overall experience with hospitality establishments, and behavioral intentions.

Context is an important concept of activity theory that determines elements and the transformation of activity [7, 8, 25]. Depending on the context, the activity goals, tasks, rules, community, and objectives may change [7, 8, 25]. In this research, context relates to place (e.g., country, city), situation (e.g., a family reunion, friends gathering, travel), and hospitality setting, including different types of hotels, restaurants, cafes, bars, and airports.

The next section of this paper reports the analysis results of the interviews concerning each activity component.

3 Results and Discussion

3.1 Object (Customer Experience with Service Robots in a Hospitality Unit)

All interviewees stated that convenient, efficient, and quick service was the most important factor of service delivered by robots. Many interviewees also described their experiences as novel, interesting, fun, and entertaining. Interviewees evaluated their experience with service robots (SRs) based on the task they needed to complete, the context, and their prior perception of the robots' functions. They also described their experience with SRs as a part of the whole experience with hospitality service, in particular hospitality or tourism establishments. The interviewees' experience with SRs was affected by all other activity components in the activity system model (Fig. 1), such as subjects' characteristics, robots, community, rules (implementation procedures of SRs), division of labor (a division of service), context, as discussed in this section of the paper. Further, we discuss possible directions for research on customer experience (CE) and practical implications in relation to each activity system component.

3.2 Subject (Customers of Hospitality Establishments)

Most of the interviewees described themselves as individuals interested in new technology and robots. Such self-perception could be the reason that all interviewees evaluated their experience as satisfactory or exciting. Most interviewees chose to patronize hotels, restaurants, or a café because they wanted to try robot service. Only two interviewees did not know about SRs working in the hotels at the time they chose their accommodations. Interviewee 2 generally preferred to use self-service technology, so she found robot service very convenient and comfortable. Interviewees 2 and 8 explained that, as introverts, they enjoy robot service over human service.

Previous experience with SRs influences customer perception and experience with SRs. Customers who experienced robot service multiple times evaluate and describe their current experience in comparison with previous experiences. When interviewees experienced robot service for the first time, they used a comparison with their image of SRs that was formed based on their imagination and other sources (e.g., movies, articles, books).

Demographic characteristics of customers also influence their perception of SRs and their experience with the service. When explaining their experience with SRs, females described their feelings and emotions, while males focused more on the functionality and utilitarian characteristics of the robots. Thus, researchers should consider using demographic characteristics, psychological traits, interest in technology, and previous experience with SRs as moderators in robot hospitality research. Likewise, industry practitioners should study their customer base carefully, understand their experiences with and preferences toward robots, and educate customers about the role of robotics in the hospitality industry (e.g., why robots are used and their impacts on employment).

3.3 Technology (Service Robots)

The interviewees had experience with different artificial intelligence-powered SRs: the robots had different characteristics, roles, and tasks. When interviewees pictured their

experience, they described robots' physical appearance, moves, motions, and voice. Some interviewees compared the SRs with movie or cartoon characters (e.g., a "robot from Star Wars") or living creatures, like animals (pets).

The interface and functional features of SRs also were central factors of CE in all interviews. Interviewees 3, 8, and 11 noted that the robot service is uninformed and lacks customization and personalization. The interface also is a factor that can affect CE because, generally, interviewees want to interact with robots. Interviewee 8 was not impressed with the robot waiter's interface: all interactions with the robot were performed via "the monitor with a touchpad." Interviewee 8 suggested it would be better if the robot had a voice recognition system so that he could communicate with the robot by voice. Thus, robot developers and hospitality managers should consider that customers expect SRs employed in the hospitality industry to have a higher level of interaction and communication abilities.

The research showed that robot design is also important for customer attitude towards robot service failures [26]. There are already many studies on SRs' anthropomorphism effect on customers (users) behavioral intentions and HRI [27–29]. However, more empirical, experimental, and qualitative studies are needed to explore robots' physical and functional features on CE and satisfaction with robot service in hospitality.

3.4 Community

Community includes customers themself, other customers, and employees that participate in service delivery or influence CE. Positive attitudes and good service of human employees that assist robots or work with robots on service delivery can affect CE with robots and overall experience. Also, interviewees indicated that they enjoyed watching the interaction of other customers, their family members, or friends with SRs. Interviews 5 and 11 confirm that SRs are an attraction for children [22], and thus, they can be a motivation for families with children to patronize the hospitality business with robotic employees. Therefore, practitioners also may consider employing robots with kid-friendly interfaces and designs if their customers are families with children and it aligns with the concept and goals of the business. Furthermore, it opens one more research problem in identifying elements of the children-friendly design of robots and their interaction interface.

3.5 Rules (Implementation Procedures of Service Robots)

Customers who repeatedly patronize the same hospitality business with SRs may notice changes in the robot operations and evaluate the effectiveness of the changes. Interviewees 1 and 2 used food delivery robots multiple times on the university campus. They described some modifications in functionality and service delivery of the robots over time and evaluated the effectiveness of the changes when describing their experience with robots.

While customers may not have an idea about the robot's implementation rules, they may notice some of the failures in the robot's implementation. For example, Interviewee 11 also described a situation when a robot runner in a restaurant dropped a plate that was being delivered to another customer because it moved" wobbly." The customers may

also notice when the service takes longer than expected. Thus, to ensure service quality and a positive CE, managers should encourage customers to report any robot failure or unsatisfactory service. For example, they can employ a satisfaction survey displayed on the robot's screen or in their mobile app.

Similarly, Interviewee 1 explained why the food delivery robot hit her on a crosswalk: "Maybe they [robots] got … a better GPS [navigation], but, you know, it's not that precise." It shows that customers take robot failures easy. Many customers accept the fact that SRs are new technology and it is not perfect yet, and "any technology may fail or brake." Lv et al. [26] came to a similar conclusion: customers tolerate service failures by robots with cute designs. However, more attention from research is needed in the exploration of customer understanding of SR implementation and attitude towards SR failures.

3.6 Division of Labor (Division of Service)

Some hospitality businesses organize the division of labor in a way when SRs support services delivered by human employees. Some interviewees find self-service more interesting in this service arrangement. For example, Interviewee 11 liked taking their plates from a robot runner instead of a waiter doing it for them in a restaurant. In this situation, there is an opportunity for experience co-creation that should be organized by management to support a more memorable experience at their establishment. However, more research is needed on self-service and experience co-creation with SRs in hospitality and tourism.

Many interviewees associated unsatisfactory experiences with robot malfunctions. Thus, when SRs work independently, customers appreciate it when human employees are present and support the service delivered by robots or can quickly come and fix the failure of the robot service. Otherwise, the robots' errors or malfunctions may affect the overall experience with hospitality service. Choi et al. [27] also found that customers are more satisfied with service recovery when human employees apologize for nonhumanoid robot failure. Similarly, Wang et al. [30] results show that a human employee's apology for a service failure increases the intention to revisit a hotel while a robot's apology has no effect; however, reactions to human employees vs robot employees' apologies are different for younger and older travelers. Thus, there is a need for studies on robot service failure and the role of human employees in robot service failure prevention and resolution.

3.7 Outcomes

Outcomes of service delivery and experience with SRs are satisfaction, overall experience with hospitality establishment, and behavioral intentions. Interestingly, half of the interviewees said that robot service did not affect their overall service. It is one more piece of evidence that customers evaluate service experience in hospitality as a whole. A positive experience with SRs does not guarantee a positive or memorable experience with a hospitality business overall. Almost half of the interviewees also said they chose a hospitality establishment to experience robot service at first, but they may not patronize the restaurant or hotel in the future. So, SRs may be an attraction or motivation to choose

a service provider, but they do not guarantee repeat business. Thus, there is a need to investigate factors of CE in the hospitality business with robot employees that lead to an overall memorable experience, satisfaction with service, repeat patronage, and positive word of mouth.

3.8 Context

The subjects' objectives of activity when interacting with SRs may differ depending on the context (e.g., place, situation, and hospitality settings). Some interviewees would like to have more social interaction in hospitality settings, which was not possible with robots that they encountered, and human service was not available. But some interviewees did not want to interact with human employees for different reasons. Interviewees 2 and 3 found robot service and distance from human employees as a precaution against COVID-19 spread. This result supports the findings by Kim et al. [31] that the COVID-19 pandemic contributed to customers' more positive attitude to robot-staffed hotels versus only human-staffed hotels. Interviewee 2 was very tired after a long trip and was happy to receive an item from a robot butler in her hotel room and not have to talk to a human employee. Interviewee 2 stayed in a midscale hotel at that time. However, she would prefer more social interaction with employees in a resort or upscale hotel. Similarly, other interviewees also pointed out that they would prefer to use SRs in quick-service or chain restaurants with known menus, where little customization and personalization is offered. But they would choose a human employee service in a fine dining independent restaurant.

The interface of some robots was described as primitive but sufficient for the service tasks and roles that they performed, for example, robots used for delivery and luggage storage. However, the limited interface and lack of social interaction were identified as a problem for more complex services like providing information to travelers at airports. Thus, CE with SRs and robot acceptance factors should be investigated and compared for different contexts in hospitality and tourism. Given the interview results, engineers should cooperate with hospitality practitioners to create or customize robots according to the concept of the business where their robots will be employed and the specific task they are assigned.

4 General Directions on Using Activity Theory for Future Research

The results of this study showed that customers evaluate service robot (SR) performance and their experience with the robots based on robot design, context, specific task and environment, support from human employees, and specific customer needs and goals of the service. Thus, future empirical and experimental research should examine customer experience (CE), attitudes, satisfaction, and behavioral intentions with robots with different designs in different contexts. For example, future research should investigate what design elements of SRs contribute to positive CE, satisfaction, and behavioral intentions in different types of restaurants or hotels; what SR experience factors are important for customers of different cultures to form positive overall experiences and satisfaction with hospitality establishments.

Furthermore, activity theory can be used to build research on experience co-creation by customers, SRs, and employees. The results of the interview analysis in this study show that hospitality patrons want to interact with SRs during the service; they also desire interaction with human employees during or instead of robot-delivered service in different situations. In addition, in the systematic application of activity theory for HCI, Bødker [32] emphasized the important phenomenon for the analysis and design of technology that people act through technology rather than interact with it. Thus, empirical research is needed to investigate motivators and factors of experience co-creation with SRs in hospitality and tourism.

Following the results of this study and calls for future research from other studies, there is a need to investigate employees and SRs working in teams to create a better CE [1]. Future research may use activity theory to study human employee roles, tasks, and operations when they work with SRs to create memorable CEs in hospitality and tourism. In activity theory, it is also important to study how the employees' roles, tasks, and operations transform when they work with SRs.

There are different modifications of activity theory and models that are based on this theory [5], including cultural-historical activity theory (CHAT) [33], human activity modeling (HAM) [10, 12] that can be used in research about HRI and CE with SRs in hospitality and tourism. Many studies call for supplementing activity theory with other theories to create more specific technology [5]. Thus, there is a need for creating new theoretical models that are based on activity theory and other theories that fit the context of CE and experience co-creation with SRs in hospitality and tourism.

The development of systems as a result of an activity is one of the central parts of activity theory [5, 8, 9]. Development can be both an object of research and research methodology in studies that are based on activity theory [9]. The activity theory's principle of development allows for conducting a thorough analysis of complex phenomena [8]. It may include methods like field experiments and observations [8], "the formative experiment which combines active participation with monitoring of the developmental changes of the study participants" [9] (p. 159), and ethnographic methods [9, 33]. However, most HCI research, including studies on HRI, is based on traditional laboratory experiments [5]. Thus, research in the domain of SRs in hospitality and tourism should use more methods to capture the development of service systems that include SRs.

5 Limitations

The study employed in-depth interviews that allowed a conceptual understanding of customer experience (CE) with service robots (SRs) and an explanation of the application of activity theory in the research that studies this phenomenon. However, this method has a limitation of generalization of findings. While the interviewees experienced different types of SRs in various hospitality and tourism settings in different countries, there are still many more types of robots that the interviewees did not experience. So, more qualitative research on CE with SRs is encouraged. All interviewees identified themselves as interested in technology and excited about meeting robots. However, other customers are less interested in technology and robots. Thus, further research is needed to understand their experience with SRs in hospitality and tourism.

6 Significance of the Study

This study introduces activity theory to the domain of hospitality robotics research. It applies this theory to understand user experience with hospitality robots and forwards direction for further research that stands from this theory. The framework proposed in this study can be used by robot developers and hospitality professionals in the evaluation of service and customer experience with service robots. This study design also contributes to building the generalizable theory of HRI based on a study of different types of robots with different tasks in different contexts [1].

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