Customer Responses to Service Robots
Comparing Human-Robot Interaction with Human-Human Interaction

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Abstract

This paper investigates how service failures affect customers by comparing human-robot interactions with human-human interactions. More specifically, it compares customers' satisfaction in a service robot interaction depending on a service failure with the customers' satisfaction in a frontline service employee interaction. On a theoretical basis, extant literature on the uncanny valley paradigm proposed that service robots would create lower satisfaction than human frontline employees would. However, I find that service robots could keep up with human frontline employees.

Based on an extensive literature research on service failures, I propose that customer satisfaction after a service failure declines far less for a human frontline employee compared with a service robot. Nevertheless, I find evidence that service robots create even higher customer satisfaction than human frontline employees after the exactly similar service failure. I base my findings on an experimental laboratory study with 120 student participants and the service robot "Pepper" from Softbank Corp.

1. Introduction

Digitalization of services is changing the way companies interact with their customers nowadays. Within the last several years, electronic services were revolutionized, so that today's world is increasingly characterized by technology-facilitated transactions. An increasing amount of customers interacts with technologies to create their own service, instead of interacting with a human frontline employee (FLE). Self-service technologies (SSTs) are „technological interfaces that enable customers to produce a service independent of direct service employee involvement [24]. Regular SSTs such as automated teller machines (ATMs), ticket machines, airport check-in kiosks, and internet based services such as online banking, already established on a large scale.

In recent years, the number of service robots as new service technology skyrocketed. Sales of service robots for professional use sold in 2015 increased by 25% and sales value increased to $ 4.7bn in 2016 (IFR). In contrast to conventional SSTs this service technology comes along with a physical appearance, and is thus much more similar to human FLEs than the SST. Service robots are already used in many industries such as retail, healthcare and hospitality industry. The French supermarket Carrefour [8] installed Pepper robots on the shop floor to give customers information on promotions and discounts and hotels as Hilton and Marriott are already experimenting with robots at the reception. At the Hospital in Liège this service robot is already working at pediatrics [10]. Even within the robotization, there is the trend to design service robots with an increasingly human appearance, such as the android robot Erica, that is almost not distinguishable from a human anymore [35]. Although these service robots are becoming increasingly human, studies suppose that customers would be more satisfied with an FLE instead of a service robot [27]. As of yet there is no empirical proof of this assumption carried out in an experimental real-life scenario. Thus, the first research question addressed in this study is: *(1) Do service robots really create lower customer satisfaction than human FLEs?*

Self-service technologies work quite well for standardized activities and routine procedures. Nevertheless, these services might fail from time to time and lead to service failures. Service failures are "activities that occur as a result of customer perceptions of initial service delivery behaviors falling below the customer's expectations" [16, p.93]. However, these failures are not only occurring in the interaction with a self-service technology but also at the service encounter with an FLE.

From service literature we know that good service recovery is important for firms to maintain customers satisfied and loyal [4]. For human FLEs there are already many studies on how to deal with a service failure (see Table 1). However, a large number of firms is still struggling with service recovery [25] of FLEs.

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This proposed research strives to provide insights on the effects of a service failure on customer satisfaction, comparing human FLEs with service robots, and to answer the second research question:

(2) How does a service failure impact customer satisfaction with a service robot compared to an FLE?

2. Literature

So far, many studies have investigated service failures, service recovery and corresponding customer responses. However, the vast majority of this research stream relates to traditional service encounters in a human-human interaction (HHI).

As digitalization of services moved forward, studies started to examine service failures in the interaction with service technologies more and more frequently. According to this development, I give an overview of the most relevant recent literature in Table 1.

First, I analyzed service failure studies regarding HHI, as it is important to know which findings from traditional service literature can be transferred to the more technology-based types of service that are increasing in the context of service digitalization. Bonifield and Cole [5] found that service failures triggers negative customer emotions and therefore affects purchase behavior in a negative way. Besides the service failure itself, the perceived controllability of the service failure plays a major role. Customer reactions are significantly more negative when the firm could have prevented the failure [9]. The level of satisfaction is also negatively correlated with the degree of service failure severity [36]. Subsequently firms and researchers came up with service recovery strategies to cushion the negative effects of service failures. However, customer satisfaction is always lower after a service failure and recovery than for an appropriate service [23]. After a service failure, customers have high recovery expectations and even high recovery performance is not enough to satisfy customers as if there was no service failure [23]. Finally, the effect of service failure recovery also depend on the context of the interaction. Leisure customers are more satisfied by recovery than business customers are [21] and if customers have high expectations of relationship continuity they have lower recovery expectations [15].

Second, I give an overview of service failure studies focusing directly on services that are provided through technologies. Many studies already focused on e-commerce and online retailing and a few studies already examined the interaction with self-service technologies apart from web-based services. There seems to be a difference between online and offline SSTs, as online customers blame themselves more and expect less service failure recovery than offline customers [14]. In line with the results from HHI [15], dissatisfied SST customers are less likely to complain about a service failure if they already had many appropriate service interactions with the SST [16]. Service recovery might lead to customer satisfaction but this still does not ensure repurchase intentions [16]. In case of a service failure recovery, it is important that the SSTs provide immediate recovery to reduce negative attributions and increase customer satisfaction [11]. Employee assistance might help to solve the problem, but it even increases the negative attribution to the SST [11]. The extent of the service recovery activities depend on the customer assessment of fairness. If the customer perceives distributive justice in a way that the outcome of the recovery is fair, this increases repurchase intentions [22]. In comparison to FLEs, customers may prefer to use an SST if it solves a need, is easy to use, avoids service personnel, safes time and money, and provides a better availability [24].

Nevertheless, to my knowledge there is no research so far examining service robots in the context of service failures. On the one hand, many results of the service failure research can be easily transferred to the interaction with service robots. On the other hand, service robots differ significantly from other service technologies through their physical appearance.

3. Conceptual Background

As antecedent of satisfaction with a service robot, I rely on the uncanny valley paradigm, as it shows the relation between the appearance of robots and the corresponding acceptance.

The uncanny valley paradigm suggests that a robot's degree of human likeness relates to feeling familiar with the robot. [27]. However, there is a drop in this positive relationship as there is an increased sensitivity for defects, as the robots almost resemble humans as shown in Figure 1 [28]. Mori [27] described this effect as uncanny valley.

As this study compares a service robot that is far away from an almost human-like appearance (see "humanoid robot" in Figure 1) with a human FLE (see "healthy person" in Figure 1), the uncanny valley itself is not of interest here. Nevertheless, this paradigm claims that a more human-like appearance leads to a higher familiarity.

Table 1. Literature review about customer responses to service failures with self-service technologies

Author/s	Year	Title	Content	Data	Framework	Customer Response
Dabholkar and Spaid [11]	2012	Service Failure and Recovery in Using Technology-Based Self-Service: Effects on User Attributions and Satisfaction	• Effects on negative customer/user attributions to the service provider for services using technology-based self-service technologies	Laboratory Experiment (N = 368) Student Sample	• Failure recovery (yes/no) • Anxiety level (high/low) • Source of failure (customer/kiosk) • Employee assistance (yes/no)	• Customer satisfaction with the failure/recovery experience • Negative attribution to kiosk • Negative attribution to store
Harris, Mohr, and Bernhardt [14]	2006	Online Service Failure, Customer Attributions and Expectations	• Examination of the differences in consumers´ attributions of blame for service failures and its effect on their expectations for recovery in both online and offline settings	Survey (N = 342) Non-Student Adults	• Different service scenarios (bank, airline) • Service medium (online, offline) • Attribution of blame	• Online subjects blame themselves more for the service failure than the offline subjects • Online subjects expect less service failure recovery than offline subjects • More customers complain, the greater the service failure is
Holloway and Beatty [16]	2003	Service Failure in Online Retailing - A Recovery Opportunity	• Examination of the service recovery management of online retailers • Types of service failures which happen during online shopping • Only 5 to 10% of dissatisfied customers choose to complain following a service failure	Critical Incident Study (N = 295) Online Shoppers	• Delivery problems • Website design problems • Customer service problems • Payment problems • Security problems	• Not all dissatisfied customers complain as they already ordered successfully many times • Many customers were not satisfied by the retailer's recovery effort • Even satisfaction with the recovery effort does not ensure repurchase
Lin, Wang, and Chang [22]	2011	Consumer Responses to Online Retailer´s Service Recovery After a Service Failure	• Investigation of consumer responses to online retailer service recovery following a service failure • Existence of service recovery paradox within the context of online retailing? • Main effects and interaction effects of the dimensions of service recovery justice	Laboratory Experiment (N = 225) Student sample	• Distributive justice • Procedural justice • Interactional justice (effects on customer satisfaction in online retailing)	• Distributive justice has a positive influence on repurchase intention • Interaction between types of justice influences: ○ customer satisfaction ○ negative WOM ○ repurchase intention
Meuter, Ostrom, Roundtree, and Bitner [24]	2000	Self-Service Technologies: Understanding Customer Satisfaction with Technology-Based Service encounters	• Categorization of SST failure incidents to discern sources of customer satisfaction and dissatisfaction with SSTs • Discovering the relationship between incident category and customer responses	Critical Incident Study (N = 823) US-nationwide online sample	• Technology failure • Process failure • Poor design • Customer-driven failure	• Customer attribution • Complaining behavior • Word of mouth • Repeat purchase intention

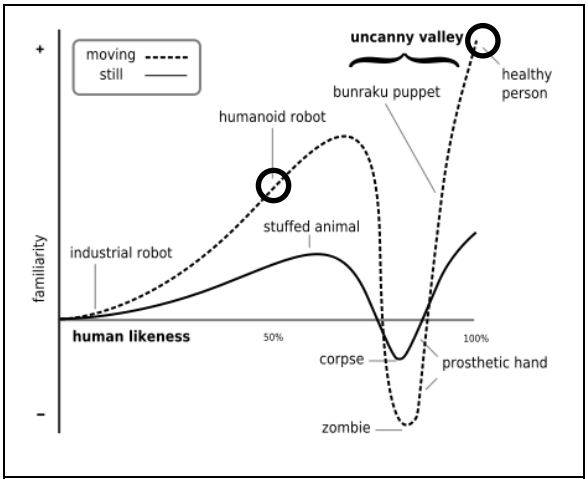

Figure 1. Uncanny Valley Paradigm [5]

The uncanny valley paradigm provides us insights to more deeply understand customers' responses to the two different service representatives (service robot versus FLE), as the degree of human likeness is an important robot perception dimension [3][6][28]. Specifically that means that customers in the totally human-like FLE interaction experience higher values of familiarity, whereas customers interacting with the less human-like service robot experience lower values of familiarity with the service representative.

4. Hypotheses Development

According to the uncanny valley paradigm, I propose that customers experience a much higher familiarity with the human FLE than with the service robot as the robot is much less human-like (see Figure 3).

In service interactions, customer familiarity leads to customer satisfaction [30]. Therefore, I propose that customers interacting with an FLE experience high levels of satisfaction. Accordingly, I propose that customers interacting with the service robot feel less familiar with it as service representative and therefore experience lower levels of satisfaction compared to the customers of the FLE (see Figure 2).

As most of our participants are already used to service interactions with FLE but still have only little experience with service robots, this may further increase the familiarity with the FLE compared to the rather unknown and eerie service robot. Thus, I propose:

H1: Customer satisfaction is higher for the interaction with a human FLE compared to the interaction with a service robot.

I assume that this effect is robust enough to withstand even an unpleasant service encounter after a service failure. Although literature proves a distinct decline of customer satisfaction after a service failure [23], I still propose that the human FLE leads to higher values of customer satisfaction compared to a service robot after a similar failure.

Moreover, most customers were still little experienced regarding the interaction with service robot. This may lead to a certain degree of anxiety toward the communication capability of the service robot [29] in case of an unscheduled failure that might require a more intense discussion with the service representative. Compared with the human FLE, the conversation with the robot might be inflexible and the robot might be unable to understand complex situations. A service failure might be a complex situation where customers might not want to rely on a service robot but rather on a human FLE. They might be less satisfied with a service robot in that situation.

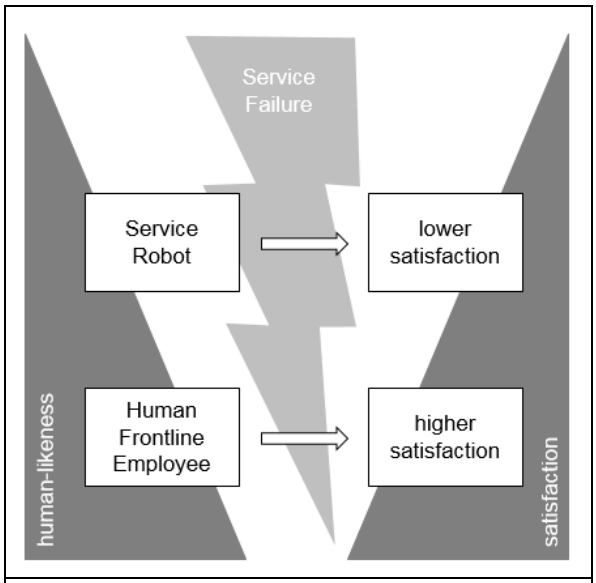

Figure 2. Human frontline employee leads to higher satisfaction than the service robot

Söderlund [30] found the opposing effect that familiarity is associated with more extreme customer responses like a stronger decline in customer satisfaction after a low service performance. However, his familiarity was related to the type of service and not linked to familiarity with the service representative. Therefore, I chose a hotel check-in and assured that all participants were familiar with such a hotel check-in.

In this study, the familiarity refers to the service representative itself and our manipulated severe service failure goes far beyond rather lower level of

performance. Therefore, I propose that the effects of anxiety toward the complex communication with the robot and the unfamiliarity with the robotic technology outweigh the situational effects and assume that:

H2: In case of a service failure, customers are more satisfied with a human FLE compared to a service robot.

5. Data Collection

5.1. Mechanical basis and manipulation preparation

As mechanical basis for the experiments, I used the Pepper robot from Softbank. This robot is already widely applied in retail and hospitality industry [19]. As Figure 3 shows this robot is clearly distinguishable from a human appearance, even though it is already a humanoid robot. Therefore, this robot clearly ranges on the left side of the uncanny valley.

I relied on the Wizard-of-Oz method [12][20], applying a remote-controlled robot in this experiment. The robot operator followed a standardized service script that was designed based on a real hotel situation.

The robot communicated via voice, gestures and showed pictures of the hotel rooms on its tablet. I prepared a different script for each manipulation group.

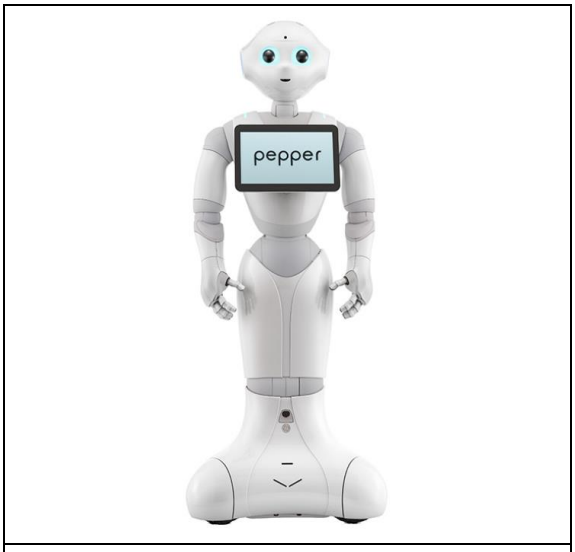

Figure 3. Pepper robot as mechanical basis [33]

5.2. Experimental setting

To run the experiments in a setting as realistic as possible, the setting of a hotel reception was built up that resembles a realistic hotel situation, which was guided by the design of established experimental studies [31][32].

Before the participants (N = 120, average age of M = 22.5, SD = 5.2; 43% female) started with the interaction, I briefed them in a separate room regarding their task during the interaction, informed them that they were taking part in a scientific experiment, and asked for demographic data.

After this instruction, the participants were guided to the hotel lobby. There they had to complete the check in with the service representative, which was either a human FLE or a service robot respectively. During the interaction with the robot, the participants had no knowledge about the operator and were told that the robot acts autonomously.

Subsequent to this interaction, the participants filled out the post-experimental questionnaire, rated the level of satisfaction they experienced with the service representative and took part in a small interview with the experimenter.

5.3. Experimental design

In this experimental study, I applied a between-subject design to avoid learning effects. The participants were randomly assigned to one of the four experimental conditions. There were two types of service representatives: a well-trained human service employee and a service robot. Both of them acted according to a detailed service script. However, there were two different service scripts: one contained an appropriate service where the customer could check in without any complications, whereas the other service script contained a service failure. The failure refers to the reservation. The previously booked suite was not available anymore and instead the participant received a much smaller, less comfortable room that was far away from the accompanying friends. Pictures of both

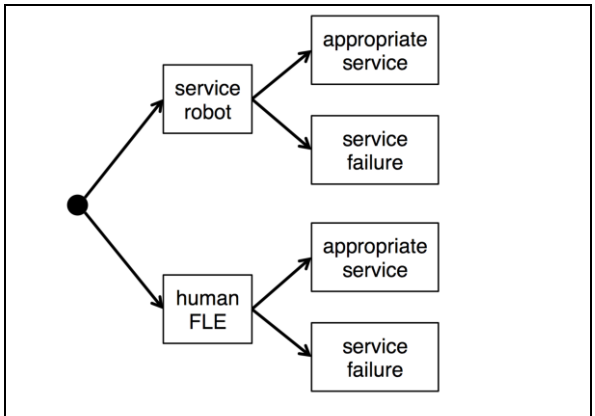

Figure 4. Experimental conditions

room sizes were presented by the service representative to give the participant an idea how much smaller and less comfortable the new room was.

However, the service representative (service robot or FLE) took responsibility for the service failure admitting that they made a mistake. There was no way to get a better room or compensation in the setting. Figure 4 gives an overview about the four experimental conditions of this study.

6. Results

6.1. Customer satisfaction with the service robot compared to the frontline employee

As first step, Table 2 shows the results from the two experimental conditions with appropriate service by the FLE and the service robot. Subsequent to the interaction, the participants were asked to rate their satisfaction with the service representative. Customer satisfaction was assessed through a five-item scale that was developed based on extant service literature [7][17].

Table 2: Differences in Customer Satisfaction

Customer Satisfaction in the setting with a …[1]	N	Mean Value	Std. Dev.
Service Robot	30	6.08	.90
Frontline Employee	30	5.79	.96

*Notes: [1]Measured on a 7-point Likert scale: 1 = not at all, 7 = extremely; * $p \leq .05$.*

In total, I had 30 participants interacting with the service robot delivering an appropriate service. They experienced a high level of satisfaction with the robot (M = 6.08). Based on the uncanny valley paradigm, hypotheses 1 assumed that human FLEs might cause higher levels of customer satisfaction as they are more human-like. However, the 30 participants interacting with the FLE experienced an overall satisfaction that was on a similar level (M = 5.79) with the service robot. This value is even slightly lower than the satisfaction with the robot (Δ = .29) although the difference is not significant (p = .19).

Thus, hypothesis 1 is not supported as the service robot leads to comparable levels of customer satisfaction as the FLE. It has already been pointed out that service robot and FLE provided a comparable service based on the same service script.

6.2. Customer satisfaction after a service failure

In Table 3, I added the customer responses after a service failure occurred during the interaction with the service representative. In line with our expectations and extant literature, the service failure led to decreased levels of customer satisfaction. Customers' satisfaction with the robot declined (Δ = 1.39) after the service failure and reached a significantly ($p < .05$) lower level (M = 4.69). For the interaction with the human FLE I also observed a significant ($p < .05$) decline (Δ = 3.38) in customer satisfaction (M = 2.41).

Table 3: ANOVA and Scheffé's Post Hoc Test for Mean Differences in Customer Satisfaction

Customer Satisfaction with a …[1]	Appropriate Service	Service Failure
Service Robot (A)	6.08 (.90)	4.69 (1.89)
Frontline Employee (B)	5.79 (.96)	2.41 (1.49)
Mean Difference (A-B)	.30 (.34)	2.27* (.34)
Sig.	0.860	< 0.001

*Notes: [1]Measured on a 7-point Likert scale: 1 = not at all, 7 = extremely; N(appropriate service) = 2 x 30; N(service failure) = 2 x 30; * $p \leq .05$.*

However, hypothesis 2 focused on the different levels of customer satisfaction after the service failure comparing customer responses on the FLE with the responses on the service robot. Even after a service failure, the participants were rather satisfied (M > 4.0) with the robot's service, than dissatisfied. In contrast, those participants who interacted with an FLE were clearly dissatisfied (M < 4.0) in the interaction with the service failure. Comparing the levels of satisfaction after a service failure, the analysis of variance showed that the effect of the type of service representative (service robot or FLE) on customer satisfaction was significant, $F(3, 117) = 46.545$, $p < .001$, $\eta_p^2 = .516$. The results of the Scheffé post hoc test show that customers rate the robot significantly ($p < .05$) better (Δ = 2.27) than the FLE.

Subsequent to the interaction, I conducted a manipulation check for the both manipulations that were applied in this experimental study: service failure/ appropriate service and FLE/ service robot. Therefore, I interviewed the participants after the experiment and asked whether they just talked to a service robot or an

FLE. Second, I asked them whether they experienced a service failure during the interaction. All of the participants in the service failure conditions clearly recognized the service failure. Furthermore, the service failure was included in the service script and had exactly the same extent for the human-robot interaction (HRI) as for the HHI.

Our results show that the same service failure leads to much lower customer satisfaction with the FLE than with the service robot.

7. Discussion

7.1. Rationale for satisfaction with failing robot

Contrary to my assumptions based on the uncanny valley paradigm, I had to reject both of our hypotheses. In this experimental laboratory study, human FLEs were not able to create higher levels of customer satisfaction. Customers interacting with the service robot experienced similar levels of satisfaction than customers interacting with the FLE. This is surprising as I expected that the interaction with a real human might lead to higher customer satisfaction. It might be the case that in such a standardized rather short and less intense interaction, most customers just focus on the interaction itself and on their task and do not really bond with the service representative. As the service representative itself is out of focus, customer satisfaction does not vary significantly between the FLE and the service robot.

Regarding customer satisfaction after a service failure, this experimental study revealed results that are even more surprising. Although the participants experienced exactly the same service failure with the service robot as with the FLE, I found that customers were significantly more satisfied with the service robot than with the FLE.

How come that the customers were so much more likely to forgive a service robot compared to a human FLE?

After the interaction with the service representative, the participants were interviewed to get an impression how they perceived the service representative during the interaction. In the condition with the service failure, customers described the human FLE as 'moody', 'malicious', 'unkind', 'limited in empathy' and 'deliberately uncooperative' making them experience an 'unpleasant situation'. Although some of the participants had similar attributions for the service robot, most of them did not consider it as moody or malicious and some participants just reconciled themselves to the service failure. Statements like 'accidents happen' and 'everybody can make a mistake' rather remind of human characteristics but were made regarding the service robot.

Attribution theory postulates that if certain outcomes of an activity – such as the check-in procedure – are viewed as beyond the service representative's control, occurring service failures tend to be attributed to external circumstances [1].

Customers may assume that FLEs have more scope of action than the service robot, as they are more flexible and can even handle sudden unexpected situations. Customers see much more controllability of the situation by the human FLE than by the service robot, as the robot is naturally tied to its programming with no additional scope of action. Therefore, customers might see less controllability by the robot, as they assume it has no control about the service failure itself. Previous studies showed that the perception of controllability leads to enhanced anger and less satisfaction with the service [13]. This might explain the lower satisfaction with the FLE who might be considered to have more control about the situation than the service robot.

"With SSTs [and service robots], customers create the service for themselves, so it is possible to accept more of the responsibility for the outcome" [24, p. 53][26][37] and therefore be less dissatisfied in case of a service failure.

One may also argue with different expectations customers have regarding the human FLE compared with the service robot. Despite experiencing the same service failure with the FLE as with the service robot, customers might expect service recovery from the FLE as this is already common standard after a service failure. Extant service research shows that service recovery after a service failure might increase customer satisfaction, while the absence leads to dissatisfaction [34]. However, in our scenario all participants experienced the same situation and ended up with exactly the same hotel room. There was no chance to get a refund, discounts or any other recovery.

However, customers might have little experiences with service robots offering service recovery, as companies might not yet have found a way how to proceed recovery via self-service technologies or even service robots. Therefore, customers might not have the expectation that the service robot provides service recovery. According to expectation disconfirmation theory, the same service failure might lead to a higher disconfirmation regarding the FLE compared with the service robot, as expectations toward the FLE were already higher from the beginning. The higher the level of disconfirmation, the lower the satisfaction predicted by this theory.

In line with the definition of a service failure as an activity, "that occur as a result of customer perceptions

of initial service delivery behaviors falling below the customer's expectations or zone of tolerance" [16, p.93][38], the customers might have perceived the FLE's service failure as more severe, as they had different expectations compared to the robot.

7.2. Research Implications

Starting point for this study was the observation that companies start to rely increasingly on service robots. From service research we know, that it is crucial to handle service failures with great care, as this may lead to extreme customer reactions such as dissatisfaction, loss of loyalty, and negative word of mouth for example (see Table 1).

Therefore, it is surprising that IS research has not yet examined the effects of robot service failures on customer responses. To my knowledge, this is the first study to examine customer responses on service failures committed by a service robot at the customer encounter. Robotic research is a rapidly growing research stream. However, to my knowledge it has not yet reached the depth to examine service failures comparable to those caused by human FLEs. So far, the focus is more on robot acceptance and on functional failures. In addition, service research did not examine service robots in the context of service failures and customer responses although this is an increasingly present phenomenon in organizations applying service robots with customers. This study contributes to that research gap by examining customer responses on robot service failures.

Second, I attempted to more deeply understand the interaction of the uncanny valley paradigm with attribution theory and confirmation-disconfirmation theory and the effects on customer responses regarding service failures in HRI. The results show that customer responses to service robots differ strongly from responses to human FLEs – in a way that is not consistent with extant assumptions from the uncanny valley paradigm.

7.3. Managerial Implications

This study contributes to decision-makers in the field of digitalized services. We observe companies relying increasingly on service robots in interactions with customers. Even in the traditional interaction between human FLEs and customers, service failures occur repeatedly. As these failures affect customer satisfaction and therefore affect customer retention and profitability [16], it is quite surprising that companies are already applying service robots in the field without knowing customer responses on robotic service failures.

At that point, this study shows that service robots meet great acceptance among customers. Under regular circumstances without service failures, service robots are able to induce customer satisfaction on a comparable level as FLEs.

Moreover, this study provides insights, that customers are more likely to forgive a robot instead of an FLE after a service failure. This means that after a service failure, customers experience a higher level of satisfaction with the robot compared to the FLE.

Thus, companies should consider expanding the application of service robots or comparable digital service technologies in the context of service recovery. It may be worth exploring new ways to deliver reasonable service recovery via these technologies.

7.4. Limitations and areas of future research

The results of this study are not in line with the assumptions made relying on the uncanny valley paradigm. Further research should further specify this theoretical paradigm with additional empirical studies in real-life scenarios and various stages along the graph. Previous studies already criticized this paradigm as too simplistic and rather weak in the definition of the dimensions [2]. However, this study did not include perceptions of the appearance of Pepper, which might also influence the opinions of the participants.

Furthermore, this study was restricted to customer responses on service failures by service robots. Future research should examine the effect of robotic service recovery on customer responses, as this is supposed to be the next step after a service failure occurred.

Finally, the examined data is just based on an experimental study. Future studies should examine comparable research questions in a real-life field study when service robots are more established in organizations. Customers might show more intense reactions in real-life scenarios than in the experimental setting making a first novel experience. Continued robot encounters may change customer satisfaction over time [30], raising a need for longitudinal studies.

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