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Abstract. This paper reports on several studies in the context of implementing the humanoid social robot Pepper in a financial institution. The results show that the robot can affect the boundary relations between the roles of customer and service worker differently from common-sense expectations. While employees initially feared to be automated away by the robot, the results suggest that the relationship is more likely to change through an emotional bonding to the robot being projected to the company deploying it. Therefore, the robot might, at least partially, assume the role of the service worker as an ambassador of the company, which could recede more into the background in this regard. We discuss the implications of our findings in the context of current literature on the changing boundary relations through robot innovations.

Keywords: Humanoid robots, actor-network theory, emotions, intelligence, anthropomorphism, attachment, boundary relations.

1. Introduction

Humanoid social robots are autonomous apparatuses that interact and communicate with humans or other autonomous physical agents by following social behaviors and rules attached to their role. These robots are now inhabiting everyday discourse on how artificial intelligence is changing the way in which we work, live, and interact [1, 2]. One the one hand, humanoid social robots are heralded for support in tasks such as lifting heavy objects and beings, like elderly humans [3], act as skilled workers [4], carers [5], or service workers [6, 7]. One the other hand, robot's introduction is often feared because of automation threats. There are fundamental human concerns to become obsolete, meaningless, dependent, and socially isolated [8, 9]. In a survey of 1,000 American adults, half of them were scared that robots will take away their jobs, and 81% refused to hand over even their menial tasks [10].

Emerging scholarship has, however, started to provide more realistic accounts of the consequences of robot introduction. This work has found that robots, instead of auto-

mating job's away, they trigger changes in the boundary relations between already existing roles in work contexts [11, 12, 13]. Thereby, research has mostly considered how robots occasion changes in boundary relations among employees [e.g., 14; 12]. It thus remains to be investigated how humanoid social robots will affect the relationship between employees and customers in complex service situations. There is in fact little empirical evidence on how the boundary relationships between the employees and customers change with the introduction of a humanoid social robot.

The purpose of this paper is to investigate *how relationships between employees and customers change in result of the introduction of humanoid social robots in complex service contexts*. Through a theoretical lens of *techno-economic networks* [15], this paper considers an in-depth case study from a bank with whom we worked in an action research-like fashion to introduce the humanoid social robot *Pepper* [16] in a customer service context. Pepper is a 1.20 meters high endearingly, or even cutely designed humanoid robot who can talk, move, and interact with humans. We conducted several studies with Pepper over a period of three years. Collected data from several qualitative and quantitative sources and perspectives, including the customer, employee, developer, and managerial point of view, present ample opportunity for tracing changes in the work relationships instigated through the implementation of this technology.

Against this background, our study finds that service robots do indeed change the way in which customer-employee relations are structured. While employees feared automation, the service robot in our case became an emotionally and anthropomorphically loaded actor, with which customers bonded, in turn changing the company perception as well. This dynamic brings robots in the customer relationship to the fore, while the robot may recede service personnel to the background. These results extend evidence that robots can affect people on an emotional level and hold theoretical implications for the reconfiguring of work relationships through robot innovations [11, 12, 14]. They invite speculation on how the dynamics of work relationships might change if future robots do not only emotionally bond with humans, but also influence employer perception, and how this potentially changes the role of the employee and their self-image.

2. Humanoid Social Robots Through an Actor Network Lens

Turning to Callon's [15] approach of techno-economic networks, this section prepares us how to think about boundary relations, what they are, and what different types of relations exist. As one of the founders of *actor-network theory* (ANT), Callon speculated on how *actors* of different kinds come into being and how they develop agency. He distinguished *actors* through the way in which they circulate and exchange *intermediaries*, such as texts and technical objects, but also skilled and knowledgeable human beings, or money. An intermediary is defined as *anything that is passed around*, such as a *product* creating a relationship between a *buyer* and a *seller*. In this way, both human and non-human objects can represent what Latour [17] calls *actants*. In other words, both humans and non-humans can turn into or act as either intermediary or mediator depending on their in-situ enactment [18].

The application of ANT has several advantages in the context of tracing the changes of work relationships in the customer-service context. First, it puts focus on the relational networks, allowing one to review the customer-service worker relationship and tracing its dynamics. It sensitizes us to the fact that new actors and relationships may emerge while others become abandoned. Second, it is open for non-human objects themselves to act as mediators, which is more attuned to the current reality of trading bots acting autonomously, social bots on the internet, and artificial intelligence excelling in human-mastery tasks, such as the board game Go, breast cancer detection, or self-driving cars, thus overcoming the issue of giving ontological priority to humans. Third, an ANT approach helps us to focus on "science in action" [19]. It allows us to consider not only a single viewpoint, such as the blackboxed artificial intelligence system presented to the customer, but also the multivocal voices and networks surrounding the creation of that blackbox, such as its developers, managerial sponsors, and service employees confronted with the system.

To begin, Figure 1 shows the main boundaries and relations considered in this study, namely (1.) the relation between service worker and customer, (2.) the relation between service worker and robot, and (3.) the relation between customer and robot. The *relation between service worker and customer* is the traditional focus of customer relationship management. Within this relationship, a firm employs service workers using intermediaries – to use Callon's term – to create a relationship between the firm and the customer. As shown in Figure 2, the traditional customer-to-service worker relationship is intermediated through conversations, texts, websites to which customers are directed, messages, eventually contracts, but also ways of informal conversations to bond, such as jokes. The role the humanoid robot assumes in this actor network is originally one as an intermediary in the relationship between service worker and customer and the empirical study will explore whether this relationship transitions into a more active one in which the robot becomes part of the actor network (as already indicated in Figure 1).

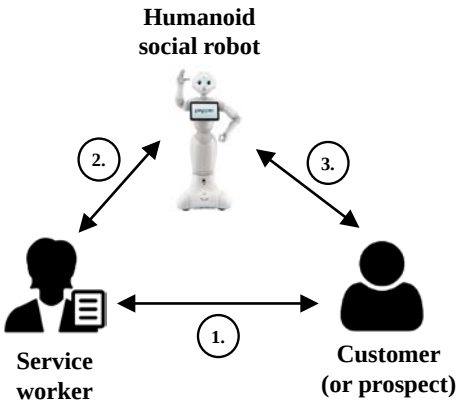

Fig. 1. Actor network considered in this study

To understand this, the *service worker-robot relationship* needs to be explored. In this context, robot's effects are different depending on the type of occupation [12]. While concerns about displacement have been raised for some job categories [20], recent work

has highlighted that robots often reconfigure work relations in more complex ways [12, 14]. In the context, a robot augmenting human tasks often incurs changes to several occupational groups, for instance, pharmacists, technicians, and assistive workers [12]. We posit that it is important to consider (role, task, status) *boundaries* between occupational groups and also between customer and service worker, and how they change with the introduction of a new robotic technology. Similar to [11], we also situate our study in the context of complex services. In this context, it is possible for tasks to become enriched or impoverished in terms of demands and content, possibly having implications for the service worker's occupational status and role, depending on the actual role that the robot assumes in the relation between customer and robot.

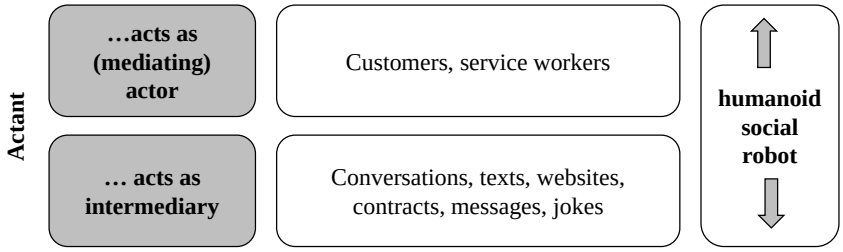

Fig. 2. Translation of concepts to our study context of customer services

The *relationship between customer and robot* needs to be explored more deeply. In our work, the notion of **attachment** comes to the fore. The premise is that human beings are naturally inclined to make and maintain lasting affectionate bonds. The quality and stability of such bonds impacts their emotional health and well-being throughout life [21]. Even given different intensities, attachment can be felt not only for family members and friends, but also for other targets, like pets or therapists [21, 22, 23]. This leads us to include that humanoids might also generate some form of "attachment." Investigating **customer attachment** like we do, Buttle et al. [24] state that feeling "satisfied" alone does not necessarily ensure a long-term relationship with whom induced that emotion. A managerial imperative is thus to identify approaches which might lead to a higher customer tenure and involvement [25]. In banking, several papers investigated customer-bank attachment [26, 27]. Recent work signals the importance of trust in attachment, for which two types of relations play a key role, namely **instrumental** and **relational** (**emotional)** attachment. Whereas *instrumental attachment* relies on convenience or access to a good deal, *relational attachment* connects customers to individual employees, branches, or the whole organization [28]. Here we make a key assumption regarding Pepper's role in the customer-service worker dynamic being explored – to investigate whether a humanoid robot can mediate (broker) the relation between service worker and customer. In our view, this will depend on whether the robot is able to effectively create instrumental and relational attachment.

Instrumental attachment concerns the physical strength, perceived intelligence, and language abilities determining the task spectrum of a robot regarding amount, variety, and depth of tasks that can be carried out. An instrumental robot is smart enough to adapt to our wishes, and to change its behavior if we don't like it. In the case of the robot Pepper, this kind of intelligence can be displayed by Pepper's dialog capacity

(over the topic of sensing emotion from dialog, see among others [29]). Moreover, dialog can, even more strongly than the robot's appearance, influence how it is perceived. Dialogue can indeed lead to biased perceptions, making the users attribute qualities to the robot that might also be inaccurate [30]. When it comes to humanoids whose implementation is still ongoing, and whose principal use is for short-term interactions without deep content, it is useful to bring together only some of the above-mentioned aspects of intelligence. Following Picard [31], in this paper, humanoids' intelligence can be captured both according to their merely cognitive abilities (their capacity to give the right information), and according to the user's perception of its dialogical intelligence, such as the robot's capacity to listen and correctly interpret a users' intention.

Emotional attachment describes emerging bonds when a robot sparks positive emotions and is perceived as human. This boils down to two fundamental concepts that have received much attention in human-robot-interaction literatures, namely *emotions* and *anthropomorphism*. While different conceptualizations have been put forward [32, 33], we can define *emotions* here as *basic affective reactions to an event* in the sense of Eckman [34] based on six basic intercultural emotions – *happy, scared, calm, angry, surprised,* or *bored.* These reactions will likely influence perception and consequent behavior. Thus, they should be included when considering the emotional attachment that would be important for a robot to broker the relation between customer and firm.

In addition to emotions, the anthropomorphic, human-like aspect of a robot [35], should also be considered. According to Epley et al. [36], **anthropomorphism** can be defined as "the tendency to imbue the real or imagined behavior of nonhuman agents with human-like characteristics, motivations, intentions, or emotions". In robotics, "anthropomorphic design" usually refers to three parts: a robot's shape, behavior, and communication skills. Epley et al. [36] highlight sociality, effectance, and elicited agent knowledge to explain why human beings anthropomorphize. Sociality relies on human desire for social connection. Effectance refers to "the need to understand, control, and interact effectively with the environment" [37]. Elicited agent knowledge refers to the extent to which people apply relevant anthropocentric knowledge to objects or entities that might be targets for the attribution of human-like qualities [37]. A humanoid's morphological appearance might allow humans to recognize shared-traits with the robot, and thereby better interact with it [38]. It has also been demonstrated that the more anthropomorphic a robot is, the greater the human's receptivity is to advice provided to them by the robot [39], the extent to which humans will empathize with a robot [40], or engage in a joint human-robot task for successful task completion [41]. According to Broadbent et al. [42], robots with a higher similarity in appearance to humans, for example, are more likely to be attributed positive character traits (e.g., alive, sociable and amiable).]. However, as Duffy [38] makes clear, a robot's design should keep a certain amount of "robot-ness", so that the user does not develop the wrong expectations of the robot's capabilities. There is an "uncanny valley" as similarity to a living being becomes almost perfect. At this point, the subtle imperfections of the recreation become highly disturbing, or even repulsive. That is why caricatured representations, or humanoids like Pepper, which still keep (both in their shape and in their color) a clear "robot-ness", may be more useful than more realistic designs.

3. Study Context and Methodological Approach

3.1. Study Context

Through an exploratory in-depth case study [43], we examined the changes of relationships regarding the introduction of Pepper in a bank. Prominent financial institution, Star Bank, had developed the social and economic desire to embark on a path of digitalization and innovation over the recent years. In collaboration with the research team, the innovation laboratory of the bank launched a project in October 2018 and purchased Pepper, a bright white-colored, cute, 1.2 meters tall humanoid robot. Pepper was initially equipped with a simple software with basic features (Pepper 01), after which a second, smarter software with internet connection and more developed features (Pepper 02) was implemented by the research team. Pepper was programmed to ease the load of employees in accomplishing some of their easiest tasks, as well as offering customers specific experiences which they would not find at other banks, such as answering to common-sense questions, accessing the online banking website, or playing memory.

3.2. Design, Data Collection, and Analytical Strategy

We followed the Pepper project since its start. The first author of this paper was a part of the research team working on the first version of Pepper (Pepper 01) and followed the project since then. Four other authors were part of the research team that implemented the Pepper 02 robot. Two other co-authors supervised the Pepper 01 and Pepper 02 development and convoyed the robot throughout the study period to multiple events, including Pepper's performance at several employee and customer events. Several qualitative and quantitative studies were conducted, the most informative of which we present in this paper. Overall the study followed a mixed methods design, inspired by early studies on technology implementation in organizations [44]. We started with very open investigations consecutively narrowing them down were appropriate.

Data collection. Beyond numerous participant observations, data was collected from five occasions. In a **first study** before the first steps of the software implementation started (October 2018), the first author and the Pepper 01 team collected voices of 22 customers in one of the firm's branches. The purpose of this initial investigation was for the research team to identify which features should according to the customers continue to be implemented regarding Pepper's intelligence and interaction-related capabilities, and which features were not well received. This helped gathering first insights into how customers perceived the robot. The conversations were supported by a picture of Pepper that was shown to the participants. In a **second study**, conducted in December 2018, the first author of this paper and the Pepper 01 research team interacted with seven employees in one branch of the bank. The conversations that took place during that day were structured by asking general questions followed by more specific, Pepper-related questions. The employees, who differed in age classes and gender, indicated to be open towards new technologies. Throughout the conversation, a picture of Pepper was shown to the respondents. In a **third study**, conducted in April 2019, a quantitative survey was distributed to 18 customers of the bank at an event were the robot was

presented to customers. Participants responses before and after the interaction were recorded regarding emotional reactions as well as perceived intelligence of the robot. The age ranged from 25 to 65. Of the participants, 40% indicated that they knew Pepper before, for example from trade fairs, and most participants were interested in digital technologies. A **forth study** included experimental interactions with 19 probands. In January 2020, improvements to Pepper's software based on participant feedback were completed (Pepper 02). The experiment analyzed the emotions aroused by Pepper and correlations between the emotions and the perceived attachment to the company deploying it, and how a higher intelligence of the robot might influence these results. To prove the feasibility of this design, a small pretest had already been run with two respondents who had interacted with Pepper, from whom positive interactions and their feedback to the robot-interaction experience had been collected. Finally, a **fifth study** in February 2020 was based on further experimental interactions with probands. This simulated what would be a *spontaneous short-term interaction* with Pepper. in which groups of 15 to 17 people were invited to interact with the humanoid in as freely (casually) a way as possible. Each interaction took 10 to 15 minutes in order to give each participant a chance to interact either in an active or in a passive manner (such as a spectator may) with the humanoid. The experiment consisted of 54 participants across different age groups, genders, and nationalities. Participants varied in technological affinity and by their technological openness, indicating the degree to which they felt ready to introduce these technologies into their daily habits. Experiments expounded have been ethically certified from GfeW.

Analytical strategy. Data was analyzed individually per study as well as combined. Reports were prepared per study in which the actual results were analyzed as well as general observations were shared with the study team. In addition, field memos were written by the researchers to reflect more on the overall learnings and observations. As we were involved in the implementation as participants, we could draw on our conversations and knowledge about the context and had access to additional documents and background information from different sources of the company. We used this knowledge in first preparing the individual study results as well as creating a case narrative capturing the most important phases of the implementation with regards to changes in boundary relations as we perceived it.

4. Results

Turning to results, we develop and present a comparative table, where we outline different periods and trace what the perceptions or actions of each group (employees and customers) of the robot in each period of implementation. In table 1, we summarize from the employee and customer perspective the perceptions of and relations towards the humanoid robot which the rest of the section will explain.

Initial enthusiasm. From both a customer and employee point of view, study 1 showed a positive attitude towards Pepper and showed that the fear of contact with the robot was very low (as one respondent remarked, "I would find it cool if Pepper would be here"). During the investigation, respondents' statements proved that especially

younger people were very open to Pepper's introduction in the bank, whereas older respondents showed a little more resistance to the use of Pepper. These findings from study 1 confirmed that while neither the group of customers nor service workers were homogeneous, there was a general urge to interact, and that both roles anthropomorphized Pepper (as one respondent in the pre-test to study 4 noted, "I was very surprised how well Pepper was able to use his gestures. At times I felt as if I was talking to a human being"), although its speech and dialog capabilities were very limited.

Table 1. Main observations during the different phases of the implementation

	Employees	**Customers**	**Robot**
1. Initial enthusiasm	Most of the interviewed employees liked the humanoid's appearance and hoped for help with easy tasks. (Study 1)	Interviewed customers showed a highly positive attitude toward the introduction of the humanoid. (Study 2)	The robot acts as an intermediary between company and customers. No extra software implementation, only pre-integrated CMS. The robot was not deployed, only a picture of it was showed.
2. Fear of automation	Many employees confessed to have initially felt scared of the robot possibly stealing their job. This fear was however antecedent the interview. (Study 1)	Customers hold general fear towards robots from popular narratives, but do not perceive Pepper a threat to job automation given its appearance (Study 2)	The robot acts as an intermediary between the company and the customers. No extra software implementation, only pre-integrated CMS. The robot had not been deployed yet.
3. Relief	After seeing the robot in action, employees felt relieved because they were now sure the humanoid could have never taken their job away. (Study 1)	Business customers felt amused, entertained and interested. The humanoid's perceived intelligence was relatively low and not scary (Study 3)	The robot acts as an intermediary between company and customers. Implementation of basic features: dancing, playing quiz, giving presentations, taking up poses
4. Enhanced perceived intelligence	Employees are curious to learn about new features but do not see new threats (when presented at event with research team)	Interviewed customers perceived robot as more intelligent, recognized its enhanced cognitive skills and showed overall sympathy toward it. (Study 4)	The robot becomes an actor itself. Further features: internet connection, NLP/AI based system (Google Dialog-flow).
5. Reconfiguring emotional attachment	A humanoid robot might generate attachment to the company, like a human employee. (Study 5)	Respondents felt overall more attached to the deploying company after the interaction. Emotions and intelligence played a key role. (Study 5)	The robot becomes an actor itself. Further features: internet connection, NLP/AI based system (Google Dialog-flow).

Similarly, during study 2, employees expressed their first thoughts about the robot. It was noticeable that they had a very positive attitude towards the robot. Words such as "cute", "sweet" or even "friendly" and "appealing" were used to describe Pepper. Only few employees remarked that Pepper needs getting used to and looks very colorless.

Fear of automation. While initial enthusiasm had been present in the early phases of the implementation, it was also noticeable that many employees stated that *they had*

felt at first worried that a robot might take their job away: “It shouldn’t do consultations, the customer relationship is my job”, said one respondent. Customers in turn held general fear towards robots from popular narratives, but did not perceive Pepper a threat to job automation given its appearance (Study 2)

Relief. Throughout the progress of the project, it was interesting to hear how service workers had changed their mind about the introduction of the humanoid: many of the employees were relieved. Once they had seen the robot and tested its abilities, their fears had mostly dissipated: the humanoid would primarily be seen as a useful, entertaining tool addressing very basic tasks, but could not substitute them (neither in their consultancy work, nor in their interpersonal relationship with the customers). After seeing it, an interviewee stated: “Personally, I have no problem with the introduction of the humanoid, we're not redundant, he will definitely not take our job”. In summary, employees showed an open, positive attitude towards Pepper's use.

From an ANT perspective, these results suggest that the employees feared that the humanoid social robot would *disintermediate* their relationship to the customer due to automation. However, the white, sweet and child-looking robot that the bank adopted was by no means capable of automating all tasks away. This led employees to be more comfortable with the robot and removed some of the initial barriers toward Pepper’s adoption into the work environment.

A survey distributed to customers (study 3) asked about their emotional reactions to Pepper as well as how they perceived the intelligence of the robot after they had observed one proband interacting with the robot. Responses were collected on five-point Likert scales, where five indicated the highest approval. The results for emotional reactions were as follows: Emotional involvement was rated as 3.44. ‘I feel well’ was rated at 3.06. ‘I feel amused’ as well as ‘I feel curious’ were rated at 3.77. ‘I feel uncomfortable’ was rated at 2.0. Of the participants, 33% used the attributes ‘cute’ or ‘nice’ to describe the robot. Also, 20% used the attributes ‘amusing’ or ‘entertaining’ to describe it. These results indicated a high level of interest in the robot as well as generally more positive and comfortable feelings.

Regarding perceived intelligence, the average rating was 2.78 on the question ‘do you find Pepper intelligent’. The respondents remarked that its capabilities should be improved through programming and that the interaction felt ‘scripted’. Interestingly, some respondents anthropomorphized the robot, for instance by saying that ‘she has expressed her will’. These first investigations suggested the relevance of our constructs such as emotional reactions, intelligence, and anthropomorphism, both on the customers’ and on the employees’ side, and informed further experimental investigations.

Enhanced perceived intelligence. After further features had been implemented, an experiment was conducted consisting of 19 participants’ short-term interaction with Pepper accompanied by quantitative surveys (study 4). As can be seen from Table 2, probands rated the perceived competence of Pepper and perceived dialog capabilities significantly higher than the baseline. From this observation, it could be concluded that the integration of knowledge related to the bank was a most important factor to address perceived competence, which we see as a measure of intelligence. From the experiments, it could also be seen that Pepper aroused emotions, since participants felt sympathy regardless of its competency. Together, the results suggested that through the

Pepper 02 implementation, especially instrumental attachment between customers and robot could be increased through enhanced intelligence of the robot, while emotional reaction played an important role across the entire implementation.

Table 2. Rating of the humanoid social robot's capabilities in different domains.

	Pepper 01 (Baseline)	Pepper 02 (Final System)	1 vs. 2: $p < 0.05$?
Competence	2.02	4.00	Yes
Dialog	2.40	4.05	Yes
Anthropomorphism	1.98	2.70	No
Sympathy	3.40	4.55	Yes

Reconfiguring emotional attachment. Study 5 mainly examined the influence of intelligence, emotions and anthropomorphism on company attachment. It was also considered whether the "smarter" software implementation developed by the research group (Pepper 02) had a higher positive influence as suggested by study 4. Worth pointing out is that the specific implementation (Pepper 01 or 02) did not count as highly – contrary to study 4. Yet the experiment had been affected by a slow connection to the internet, which made "smarter" Pepper slow down. Further, during the free interaction with the robot, participants were not always informed on the robot's complete feature set. Some extra features of Pepper 02 remained undiscovered. Based thereupon, Pepper 01 versus 02 differences were not further interpreted in this study.

Tab. 3. Regression models explaining company attachment (study 5)

DV: Attachment to company	**M1: Controls only**	**M2: Emotions**	**M3: Emotions and appearance**	**M4: Emotions, intelligence, appearance**
Intercept	2.222	-0.074	-1.019	-2.070
Controls				
Pepper 01 vs. 02	-0.103	-0.058	-0.153	-0.128
Gender	0.008	0.152	0.241	0.046
Citizenship	-0.669*	-0.140	-0.065	0.005
Age	-0.464*	-0.426*	-0.250	-0.330
Tech. openness	0.341*	0.086	0.038	0.074
Prev. experience	-0.801*	-0.395	-0.297	-0.364*
Comfortable place	0.236	0.120	0.127	0.306*
Explanatory var.				
Happy		0.608**	0.555***	0.431**
Calm		0.019	0.042	0.023
Curious		0.189	0.078	0.083
Scared		-0.349*	-0.319*	-0.263*
Angry		0.689**	0.558*	0.460
Bored		-0.121	-0.076	0.091
Robot's appearance			0.043	-0.334
Anthropomorphism			0.271	0.300*
Robot's intelligence				0.713**
N	54	54	54	54
df	7	13	16	17
R^2	0.33	0.60	0.65	0.78
Adj. R^2	0.23	0.47	0.50	0.67
Prob > F	0.0061	<0.001	0.0001	<0.001

* p<0.05, **p<0.01, ***p<0.001

As can be seen from Model 2 in Table 3, it was confirmed that *positive emotions* towards the robot (especially strong ones, like happiness) do generate a *higher attachment to the company* deploying the robot. The analysis of *Model 3* showed no support for a relation between anthropomorphism and participants' attachment to the humanoid. However, in Model 4, including intelligence, anthropomorphism correlated positively with participants' attachment to the robot. Furthermore, as can be seen from Model 4, it was also apparent that intelligence was associated with company attachment. Intelligence was measured using the four variables non-verbal skills, verbal skills, naturalness, and degree to which the robot understands a users' intention. These were combined into a single factor after the factor analysis had confirmed the feasibility of this approach. In sum, the regression analysis had suggested a significant impact on participants' attachment a company that (a) the intelligence of the robot, (b) participants' happiness aroused during interaction, and (c) the anthropomorphic appearance of the robot the company deploying the humanoid.

Taken all together, the analysis suggested that the implementation went through five phases: (1) there were initial hopes in the implementation project, (2) fears of automation on the employee side, (3) relief when fears of automation proofed unjustified within first tests of reality, (4) further enhancements in the robots capabilities, such as perceived intelligence, and (5) finally the insight that bonding of customers with a robot also evokes bonding with the company, thus reconfiguring relations of customers and a company through a robot actor on an emotional attachment level.

6. Discussion

The purpose of this paper was to explore *how boundary relations change with the introduction of humanoid robots in the context of complex customer services*. This meant not only looking into technical automation potential, but to also research which emotional reactions the interaction with a humanoid could evoke in its interlocutors, and how their general attachment to the company deploying it was subsequently affected. Towards this aim, the paper presented results from five studies within the context of implementing Pepper, a humanoid robot, in a financial institution.

The results – especially of the fifth study – suggest that a humanoid can indeed increase people's attachment to the company the robot is employed by. Gender, citizenship, age, technology affinity, interaction environment, and previous experiences did not influence this attachment. The anthropomorphic aspect of the robot clearly played a significant role, but what had an even stronger impact on people's increased attachment to the bank institution were strong positive emotions evoked during the interaction with the robot (e.g. happiness), and the perceived intelligence of the robot itself.

Especially the perceived intelligence of the robot generated stronger attachment to the company. If we allow a comparison between a humanoid robot like Pepper, and a dog, the pet people tend to anthropomorphize the most [23], the findings align with what Kurdek [45] observed in his study about attachment towards pet dogs. Starting from the assumption that attachment is most likely to occur when positive interactions

take place, he demonstrated that, together with energy, affection and emotional reactivity, a dogs' intelligence was key in generating owners' attachment to the animal. In a nutshell, our results suggest that a humanoid can become an embodied avatar of a company – more versatile than an animal ever can.

Together with unveiling the principal factors that might lead to a stronger attachment towards the company deploying a humanoid, i.e. pleasure generated during the interaction and perceived intelligence of the robot, the present work leads to a new, unprecedented observation. At the beginning of the Pepper project, voices of both customers and employees were collected. The results show that employee's initial skepticism towards introducing a humanoid had stemmed from their fear that the robot could away their current position. However, their initial skepticism had been quickly alleviated by employees' own assessment that a robot like Pepper was somewhat limited in its skills, and that it would have not be able to serve the bank beyond more simple tasks like reception, providing general information to and the entertainment of customers. Pepper might not be able to perform employees' main job, which is consultancy, nor substitute the interpersonal bond between customers and employees. The results of this paper show that a humanoid can generate, increase, or in general alter, a customers' bond to a company. Tasks that were originally done by humans can be automated, but from a different perspective than expected: not from a task level, but from an emotional level. The experiment ran in February 2020 shows that there is a category of machines (the humanoid robots) that can change or influence companies' identity among their customers, as well as the nature itself of customers' loyalty and bond to them.

In the sense of changing role descriptions, our work also confirms the main consideration of Barret et al. [12]. In fact, in their paper examining the influence of robotic innovation on the boundary dynamics among three different occupational groups working in a hospital pharmacy (i.e. pharmacists, technicians, and assistants), the authors showed that "the adoption and use of a robotic innovation by multiple occupational groups can reconfigure the boundary relations among them, with important implications for work practices, roles, and status" (p. 1464). In the same way, Oborn et al. [11] found similar results in their work looking into how the social and technical elements of robot applications can influence and restructure social dynamics. Our study adds to this stream of work the observation that a humanoid robot can not only alter boundaries across occupational groups but also boundaries between an occupation (service workers) and customers. A humanoid robot such as Pepper has the potential to automate very simple (instrumental) tasks but more importantly take over some emotional attachment functions of the service worker.

The present paper adds to research on human-robot interaction (and specifically research on humanoids in organizations) in two main regards. On the one hand it uses a novel research model to investigate the emotions people feel when interacting with a humanoid, as well as the factors influencing them, and the implications for the overall attachment they feel towards a company deploying the humanoid. On the other hand, it also provides a case study elucidating the path towards deploying humanoids in companies. The authors believe the opportunities to be twofold for a company like a bank deploying a humanoid like Pepper. The humanoid could both help improve the perceived innovativeness of the company, while also leading to stronger customer bonds.

Organizationally and from a long-term perspective, this will also have consequences for the employees and their role, status, and tasks.

7. Conclusion

Human interaction with humanoid robots usually arouses emotions. If the humanoid looks sweet, funny, friendly and not too human-like (like Pepper does), these emotions are mostly positive. Studies point out that a customers' bond to a product can generate attachment to the company that this product is linked to. This led us to ask how a humanoid social robot could change the boundary relations between customers and employees in complex service situations. Our findings from study 5 suggest that perceived intelligence, positive emotions, and anthropomorphic characteristics of the robot are associated with greater emotional attachment to the company deploying the robot.

The results of our study also lead to a further consideration regarding our initial research question. As mentioned in the beginning, Callon [15] defines a techno-economic network as a "coordinated set of heterogeneous actors which interact more or less successfully to develop, produce, distribute and diffuse methods for generating goods and services" (p. 113). According to Callon, actors define one another through interactions, meaning in the intermediaries that they put into circulation (p. 135). So it happens, for example, that the interaction between a producer and the customer happens through the product. An actor takes the last generation of intermediaries and transforms (combines, mixes, concatenates, etc.) these to create the next generation (p. 141). In this case, importantly, that is the next generation of customers.

Applied to our case study, the original actors were the bank and its customers, and Pepper, while being a hybrid mixture of human and mechanical, was conceived to act only as an intermediary in the customer relationship with the bank. The results of our investigations show a shift in the role of a humanoid like Pepper within an actor network. One in which Pepper can be seen not only as an intermediary, but as an actor as well. By using texts, voice recognition, music, websites, etc. (all intermediaries), a humanoid can work as an actor itself. By arousing certain emotions and enhancing users' attachment to the bank, the humanoid is beginning to transform the network of the relationship between customer and service worker. It can change, or at least influence, a companies' identity, and the nature of customers' loyalty and bond to them.

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