Non-dyadic human–robot interactions and online brand communities

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Abstract

Purpose: This research investigates and conceptualizes non-dyadic human-robot interactions (HRI).

Design/methodology/approach: We conducted a netnographic study of the Facebook group called "iRobot – Roomba," an online brand community dedicated to Roomba vacuums. Our data analysis employed an abductive approach, which extended the grounded theory method.

Findings: Dyadic portrayals of human-robot interactions can be expanded to consider other actants that are relevant to the consumption experiences of consumer robots. Not only humans but also nonhumans, such as an online brand community, have a meaningful role to play in shaping interactions between humans and robots.

Originality: Unlike most previous marketing and consumer research on human-robot interactions, we show that different actants exert agency in different ways, at different times, and with different socio-technical arrangements.

Research implications: The present study moves theoretical discussions on HRI from the individual level grounded in a purely psychological approach to a more collective and sociocultural approach.

Practical implications: If managers do not have a proper assessment of human-robot interactions that considers different actants and their role in the socio-technical arrangement, they will find it more challenging to design and suggest new consumption experiences.

Keywords: human-robot interaction; consumer robots; online brand communities, non-dyadic human-robot interactions; Roomba; netnography

Introduction

Robots are everywhere and in everything, from smart surveillance (e.g., iPatrol Riley) to disaster response (e.g., Packbots), from education (e.g., Professor Einstein), to entertainment (e.g., Disney's Na'vi Shaman), and from healthcare providers (e.g., Grace), to hotel lobbies (e.g., Hilton's Connie), so for better or worse, these complex machines are now part of our daily lives. Bartneck *et al.* (2020) argue that robots are not mere machines but are social actors that carry cultural meanings and have a strong impact on shaping social settings. This means that our interactions with them go beyond an instrumental relationship of master-servant, such as the one we might experience in service contexts (Kim, Schmitt and Thalmann, 2019; de Bellis and Venkataramani Johar, 2020). In our homes, for example, we are impressed by how they look and by their capabilities (Delgosha and Hajiheydari, 2021); some of us even fall in love with them and have sex with them (Belk, 2022), while others channel their faith through them (Löffler, Hurtienne and Nord, 2019). Consumer robots are designed to make consumers happier and their lives easier. They are created not only to provide enchanting (Belk, Weijo and Kozinets, 2021) and pleasurable (Huang and Rust, 2021) experiences, but also to avoid the frustrating (de Graaf, Allouch and Klamer, 2015) and even weird (Hoyer *et al.*, 2020) ones.

Past marketing and consumer research investigating human-robot interactions (HRI) has mainly portrayed them as a rational, transactional, and interactional relationship between two individuals (e.g., Huang and Rust, 2021; Letheren *et al.*, 2021; Esfahani and Reynolds,

2021; Kim, So and Wirtz, 2022). Precisely because of the current pervasiveness of robots, and the way we human beings create and are created by these technologies (Müller, 2016), fluid, non-static, and collective aspects of the consumption of emerging technologies, such as consumer robots, have been included in calls for research (Belk, Weijo and Kozinets, 2021; Schmitt, 2020; Puntoni *et al.*, 2021; Grewal *et al.*, 2020; Delgosha and Hajiheydari, 2021; Hoffman and Novak, 2018; Gonzalez-Jimenez, 2018; Kang, Diao and Zanini, 2020). This rising interest is also a reflection of the current annual growth rate (i.e., 17.45%) of the global consumer robot market, which was valued at USD 27.73 billion in 2020 and is expected to reach USD 74.1 billion by 2026 (Mordor Intelligence, 2021).

Guiding our research, we pose the following questions: *What are the structural elements of human-robot interactions? How do consumers collectively experience their consumer robots in everyday tasks?* Following the consumer culture theory tradition of sociocultural studies (Arnould, Crockett and Eckhardt, 2021; Arnould and Thompson, 2005), we conducted a netnographic study (Kozinets, 2020) involving the Facebook group, "iRobot – Roomba,", an online brand community dedicated to Roomba vacuums. This method enabled us to explore the linguistic mannerisms, the symbolic dimension of HRI, and the value systems that shape the collective experiences of such a community, and that are converted into consumer-robot interactions. By way of interpretive analysis (Belk and Sobh, 2019), we identified themes in the community's discourses, comprising the structural dynamics of negotiating human-nonhuman agency, and the learning, remembering, and improvising processes that become entwined at both the collective and individual levels. Drawing on HRI literature (e.g., Paauwe *et al.*, 2015) and online brand communities (e.g., Muñiz and O'Guinn, 2001), we conceptualize the relationships between these themes and the role they play in

shaping the continued engagement with the community and consumer interactions with robots.

In revealing the less explored but meaningful structural and non-dyadic dynamics of HRI, the main contribution of this study is to the emerging work that is being done on consumer robots in marketing and consumer research. It shows that dyadic portrayals of HRI can be expanded and consider other actants that are relevant to the consumption experience of consumer robots, such as an online brand community. The remainder of this paper is as follows. First, we present our theoretical background, which is followed by our research context and methods. Next, we set out our findings and the conceptualization of HRI. Lastly, we present the discussion and conclusion sections.

Theoretical background

Human-Robot Interactions (HRI)

First, a word on the term "robot". In 1920, the Czech writer Karal Čapek wrote the science fiction play *R.U.R.*, or *Rossum's Universal Robots*, and introduced the word *robot* to the world. *Rab,* in Czech, means slave, and the play was based on the creation of artificial humans, or *roboti* (robots), to serve humans. Considered a milestone in the dystopic plots that are found in contemporary consumer culture (e.g., *Ex-Machina*), R.U.R. shows the rise of robotic, system-based autonomous beings and the fall of the human race after a rebellion by robots (Mayor, 2018). Despite all current knowledge and technological advances, especially in embodied artificial intelligence (AI), our expectations of robots remain more or less the

same: they must help humans attain greater well-being (Wirtz *et al.*, 2018), and they obviously must not kill us all (Geraci, 2012; Belk, 2020).

In this vein, the embodiment of a robot establishes material constraints on the ways in which it can (re)act in the world, but it also represents an affordance with regard to its interaction with consumers (Paauwe *et al.*, 2015), whatever these interactions might be. Ghafurian, Ellard and Dautenhahn (2021), for example, found that during the COVID-19 pandemic, consumer robots played a meaningful role in people's ability to cope with social isolation. These machines served as social companions and helped reduce the feeling of loneliness, which led to consumers' perceptions of robots changing, and to a wish to purchase them in the future. In a more intimate dimension, Belk (2022) explains the role of robots' physical bodies and other human traits, such as their (artificial) emotions, which can shape sexual relations between a human and a robot. As he argued, the more human-like the robot, the greater the acceptance of the robotic companion and the desire to own one.

As in these previous examples, however, most of the work that has so far been carried out on HRI takes as its starting point a dyadic interaction between a human and a robot (van Pinxteren *et al.*, 2019; van Wynsberghe and Li, 2019). This individual perspective, Pink *et al.* (2020) argue, may limit our understanding of consuming robots because of the complex and multilayered social nature of human beings. After all, as social beings we create our social realities based on everyday interactions with humans and nonhumans in different social settings (Ingold, 2008; Ingold, 2000). In what follows, we detail one of the fundamental aspects of this connectedness with others that is relevant to our conceptualization of non-dyadic HRI: Online brand communities.

Online brand communities

Over the years, consumer researchers have been exploring consumer collectives that are scattered throughout the internet, and they do this by adopting either a non-communal (e.g., Arvidsson and Caliandro, 2016) or a communal approach (e.g., Lima, Irigaray and Lourenco, 2019). Regarding the latter, Muñiz and O'Guinn (2001) provide a seminal conceptualization for brand communities that was used as information for the present research. According to Muñiz and O'Guinn (2001), a brand community is a collective of consumers and fans that creates a structured set of social relations, both online and/or offline, and a coherent set of meanings for brands and their practices. In essence, it can be defined as a non-geographically bound, specialized group of consumers grounded in strong social ties between the members and a brand (Muñiz and Schau, 2005).

There are three basic characteristics of this social phenomenon: (1) It has a *consciousness of kind* by which the members connect to each other to collectively distinguish themselves from another community, as noted in Sibai *et al.*'s (2021) work on brand activism; (2) By elucidating the social dynamics of a community of self-quantifiers— consumers who track themselves with technology such as wearable devices—Charitsis, Yngfalk and Skålén (2019) highlight the *shared rituals and traditions* that are related to practices of engaging in social activities in order to corroborate the values and norms of the community; and (3) A *sense of moral obligation* motivates the contributions to the community and for members also, as in the case of negative brand relationships within communities that were explored by Dessart, Veloutsou and Morgan-Thomas (2020).

In these communal settings, the narratives that are formed around rituals enable consumers to understand each other and enrich their consumption experience because of their social connections (DuFault and Schouten, 2020). From the structural perspective that we

adopted in this research, these communities play a mediating role between consumers and the products and services they consume. As a consequence, consumers have a rich, dynamic, multilayered experience for influencing their peers in online brand communities (Cova, Barès and Nemani, 2021).

Research Context and Methods

Research Context

In 2020, driven by the COVID-19 pandemic's social context of lockdowns and work-from-home situations, sales of consumer robots surged in an unprecedented way (FutureCIO, 2021). In the case of the famous vacuum cleaner Roomba, for example, its manufacturer, the iRobot company (www.irobot.com), saw a 43% increase in sales (Mahaney, 2021). On Facebook, the biggest consumer-owned brand community is the "iRobot-Roomba," in which more than five thousand members discuss their daily experiences with different models, and post pictures and videos of Roombas performing tasks, while others seek advice from experienced consumers, and occasionally share narratives about emotional attachments to robots. Following Kozinets' (2020) suggestions for site selection, this online brand community is an adequate choice for our study for some reasons: (1) it is relevant to our research questions; (2) it has recency and frequency of members' engagement; (3) it is composed of rich data. Moreover, our selection of iRobot-Roomba as the research context followed recommendations in the literature on qualitative research (Denzin and Lincoln, 2018; Belk, Fischer and Kozinets, 2013). That is, it was theoretically driven, in addition to its relevance in the contemporary marketplace.

Data collection

As in previous marketing and consumer research (e.g., Kozinets, Ferreira and Chimenti, 2021; Wang, 2019; Ruvio and Belk, 2018), our focal procedure rigorously followed Kozinets' (2020) guidelines for conducting netnographic work. Firstly, our data collection began in March 2020 when the first author joined the Facebook group "iRobot – Roomba," in which he had to answer a questionnaire about his intention and usage of the product as a prerequisite to acceptance in the community. The first author observed discussions every day, participated by liking, sharing, and commenting, and made field notes about social situations involving interactions with Roomba vacuum cleaners. He kept detailed immersion journal notes on his engagement with the community. The journal has 20 double-spaced pages including perceptions of the community's social dynamics, different types of interaction between members and their robots, and the role of moderators and specialists in establishing the "right way" to do things. On many occasions, the first author also followed the tips and instructions found in the community to try with his Roomba, which led to deeper reflection on the consumption experience (Holbrook, 2005). Regarding the dataset (e.g., posts, pictures, and videos), as acknowledged in the literature (Kozinets, 2020; Belk, Fischer and Kozinets, 2013), netnographic sampling can be either theory-driven or purposive (Glaser and Strauss, 1970), rather than being a statistical representation of social interactions in the community. In this vein, the final dataset is composed of several screenshots, 630 posts and comments, 5 PDFs of charts for model comparison, 45 pictures, and 15 videos.

Data analysis

We analyzed emerging themes using an abductive interpretation framework (Tavory and Timmermans, 2014; Timmermans and Tavory, 2012). This was based on Belk and Sobh's (2019) suggestion for extending the grounded theory method (Glaser and Strauss, 1999) using abductive reasoning. The first analytical procedure was open coding, in which we manually analyzed the dataset to identify concepts (e.g., shared identity) and themes (e.g., improvisations). Then, during the axial coding stage, we contrasted the preliminary analysis with the literature on HRI and with online brand communities. During this stage, several extant theoretical perspectives were considered relevant for further contrasting with the concepts that emerged from the analysis (e.g., Ingold, 2008; Latour, 2005). The outcome of this second step was a refined set of possible relationships between open codes. As the last procedure, the selective coding allowed us to continue our analysis from a higher-level abstraction (e.g., agents and agency) and organize our conceptualization into a coherent story.

We went back and forth between the emerging themes, the data, and the literature to make sure our analyses were consistent. Finally, all the authors jointly reflected on their experiences of owning a Roomba and revised them thematically to achieve interpretive convergence (Belk and Sobh, 2019). Although we started our analysis without an *a priori* theory, we developed constructs and themes by way of an abductive process to understand and theorize on HRI as a non-dyadic phenomenon. Such an analytical strategy is consistent with contemporary qualitative consumer research (Janiszewski and van Osselaer, 2021; Fischer and Guzel, 2022). Both data collection and analysis stopped when theoretical saturation was achieved (Denzin and Lincoln, 2018). Our ethical protocol in this netnographic study also followed Kozinets' (2020) recommendations to ensure the non-traceability of participants: all names are appropriately anonymized, and quotes are carefully paraphrased without changing their meanings.

Findings

Our analysis of Roomba's online brand community points to the meaningful role that this community plays in shaping non-dyadic human-robot interactions, as in the case of its members. The higher-level themes that emerged from our analysis and that are central to understanding the structural dimension of human-robot interactions are: (1) *actants and agency*; (2) and *the learning experience*. These two distinct yet interrelated themes are sustained by three processes: *remembering, improvising,* and *imagining.* Figure 1 illustrates the proposition.

[INSERT FIGURE 1 HERE]

A non-dyadic human-robot interaction can be conceptualized, therefore, as a sociotechnical arrangement that has individuals, communities, nonhumans (e.g., animals), robots, and other actants that affect each other in different ways, at different times, and in different social situations. In the following paragraphs, we detail this type of interaction.

Actants and agency

Contemporary object-oriented ontologies sustain that people and objects jointly enact behaviors (Belk, 2015), although only human beings have the intentionality required for initiating such actions. This is aligned to a certain extent with extant research on HRI that places the ability to do something, or having agency, heavily on the human side (Spatola, Kühnlenz and Cheng, 2021). Gell (1998), however, explains that objects certainly have

agency but of second-order, or "secondary agency" as he called it. In this case, despite the human role needed for actions to take place, objects can do things in the world that enable, constrain, and/or otherwise condition the actions of human and nonhuman actants. From a semiotic perspective, humans, robots, and other nonhuman beings are all actants, or actors endowed with the different forms of agency that are involved in the process of creating a social reality (Greimas and Courtés, 1982).

In the case of the Roomba, members of the community often mention how the robot "says," "does," "warns," or "tells" them what should be done. Samantha's and Huff's, for example, discussed a series of errors due to possible failures in the manufacturing procedures, and their frustrations while operating the robot.

> Samantha: Another day, another error.... I just recently purchased this brand-new Roomba and it's working great, but it keeps saying to me that the i3 Roomba's self-emptying base is full and clogged... I disassembled the underneath part like it told me to and verified for supposed clogs and there was nothing there. I emptied the robot and put it in a new bag... this will be the third call to iRobot. I've been a customer for barely a month... I'm getting so hopeless.
>
> Huff: My robot keeps telling me Error 30. I did everything I could. I even exchanged the rollers and the brush wand and nothing. What should I do?

As in their examples, the attribution of agency to their robots suggests a non-instrumental perspective of these devices. Instead of functioning as a merely passive tool to be used at will, their agency is understood as initiating or guiding a certain activity or behavior (Schweitzer *et al.*, 2019).

If the online brand community is an actant that has an influence on others, this is no different. A networked group of people, as Muñiz and O'Guinn (2001) explained, has an influence over the likes and dislikes of people's experiences of consumption. Taking the online brand community as an actant in a major network, members eventually target the whole community with their posts. Chico and Karla tried to solve their problems by reaching the group as a whole.

> Chico: Hi group, I'm purchasing filters for my Roomba e5 on AliExpress, but I'm not sure about the quality. Do you have an opinion on it? Or happen to know some place selling them online so I can buy them for a good price? Thanks
> Karla: I need the group to troubleshoot something for me. My robot is the S9. After many months of my map gradually getting extra areas, I decided to erase it and start everything from scratch. Now I'm struggling to get the full remapping, because it doesn't go to areas, or it'll get stuck trying to reverse on the rug. I know it will find all areas eventually. But let's try to fix this other issue. When the S9 is failing to reverse, I've learned that if I lift either side just a little bit, it gains traction and moves. What can I do to lift the body? Do other users have this problem? Does anyone have a solution?

In response to questions like those from Chico and Karla, the community sometimes relies on protocols and documents to support further non-dyadic interactions with robots. Chico and Karla then could be considered as a proxy for "the community intervention" on their Roombas. As Muñiz and O'Guinn (2001) argued, sharing rituals and "ways of doing things" is

an essential part of an online brand community, which certainly has real-life implications, as in the case of Kimberly:

> Kimberly: Hi, I've created the iRobot models' chart for the company's official Facebook group, but I'm not affiliated or an employee there. I've noticed the image being shared here and just wanted to make sure that you have the original version. This chart is very precise because it has current models in the US, and a few that have been discontinued in the past few years. My idea is to help consumers select the best model that's best for them. I hope this helps!
>
> Ca: Hello Kimberly. Thank you for this awesome chart. I hope you don't mind that I've shared it in our community in the past.
>
> Robleds: This is the best reference out there. Extremely helpful! Many thanks!

As Robleds suggests, one member's reference can become the reference for the whole community. This chart and its information exemplify that agency, regardless of the intensity of its type, can be found everywhere (Bennett, 2010). Consequently, the typical and dyadic human-robot interaction may be expanded to the community/human-robot interaction. Although the structural dynamics of this online brand community may be mainly shaped by humans (i.e., consumers) and nonhumans (i.e., posts), it is possible to argue that other actants, such as robots, filters, customer support, floors, walls, and so on, are all part of non-dyadic human-robot interactions.

Learning experience

A true mark of this online brand community and the consumption experience involving a Roomba is the *learning experience*. This is possibly the main reason for entering a community, remaining in it, and contributing to it. Learning happens here in two ways: consumers learn how to use the product, and robots learn how to clean the environment properly. Gonzalez-Jimenez (2018) explains that both consumers and robots need to learn so that the interaction and its outcomes can be positive, and as is often commented on in this online brand community, this takes time, repetition, adjustment, and certainly patience. For example, on the consumer side, Janice posted:

> Hello everyone! I'm new to the group, and I've 80% decided to get the iRobot Roomba S9+ (great, right?!). For those of you who have it, where would be the best place to buy one? I read online that Costco has the best return policy but I'm not a member there, so could someone from the group explain to me if and why Costco is the best place? Another question: is the S9+ worth it? Please, help me as I'm willing to spend a considerable amount of money on it, but the reviews I've been reading make me skeptical. I really wanna love them, but I also need honest feedback from owners. Thank you!

Josh's account goes deeper into her frustration with the learning experience with the robot and with technical issues:

> This is the second time trying to train my S9. The first time I've tried it, I tailored it but not 100%, and of course that locks it up. Then, I've spent eight hours in the past two days "training" the robot (with five children at home, three dogs and three cats this is no

> small endeavor), and it seems to have finally found all the rooms. But it completely missed a wall that separates my kids' bathroom from my sons'. I'm sending it on another cleaning round, hoping that it'll do everything correctly. To make it faster, I was considering shutting the other doors so it could find the bathroom/wall it missed. I'm worried it will erase areas off the map. Does anyone know if this is right? I called iRobot and they said no it won't block off those rooms once they are on the map. I'm scared of undoing the map! Does anyone know for sure?

On the robot side, narratives about the device's brilliance and how it struggles to perform properly are often attributed to a lack of learning, like Josh's case. In the case of emerging technologies with some level of artificial intelligence, which is the case with the Roomba, they need to learn the map and plan the cleaning task (Das *et al.*, 2021). As Hoffman and Novak (2018) note, it is whether good or bad, this learning process is part of the object experience in the network and is essential for smooth human-robot interactions.

Humans and robots are obvious actants within this context but, as our homes are filled with furniture, plants, and animals, these nonhuman actants also present themselves as influential within a network of relations (Chalmers Thomas, Price and Schau, 2013). One of the major practices found in the online community is the anthropomorphization (Blut *et al.*, 2021), or even the zoomorphization (Healy and Beverland, 2013) of the Roomba. A remarkable but disgusting shared situation is the "Dog Poop Picasso," when the robot does not identify animal feces on the floor and spreads them around the place (see https://youtu.be/ASjLXrbVlMw). Dimitry's struggles illustrate the role of other actants in this human-robot interaction:

Dimitry: My parents' robot 780 "created" the famous "Dog poop Picasso." How should I clean the robot?

Robert: Make sure to have all the sh*t out of it, otherwise it will smell every time it runs.

Dimitry: I assume you're talking from painful and smelly personal experience?

Robert: Unfortunately, yes. I thought the cat had a stomachache or something. It was terrible!

A silver lining here may be new models that detect such an obstacle, as Sandra mentions:

I don't remember the exact model, but I've watched a YouTube video, and one Roomba could detect pets' mess and once it detects it, the robot goes around it. It's too late for you, but I thought I'd mention it anyway, lol

In learning how to interact with the robot, consumers experience and share three processes with the community: remembering, improvising, and imagining. These are even more intertwined between consumers, robots, and the community.

Remembering, improvising, and imagining

On the one hand, Roombas, which in a way are anthropomorphized, are blamed for being stupid or dumb because they do not remember tasks and routines. On the other hand, consumers also struggle to remember what to do to get things done, as in the case of Tom and Jack:

> Tom: My robot is stupid! Maybe it needs a brain transplant? Is it joking? I sent it home after it went all over the house in no logical way, and it ran into the dishwasher for about 30 times, which is the same appliance it had already hit 30+ times before. Does anybody's really work properly?
>
> Jack: Mine is senior...but (1) You need keep the sensors clean all the time. (2) You must have sufficient lighting, and (3) Your Wi-Fi signal must be good. We had problems at the beginning, but I can't remember exactly what we did, but it was some changes in the router settings.

Because consumers, robots, and other actants all share the same space (e.g., a living room), unpredictable things happen. On this, Landowski (2005) explains that even in cases of chance, actants enter an adjustment mode based on their characteristics, social roles, and affordances. Accordingly, improvisation becomes the guiding dynamic in the socio-technical arrangement, just like in Steve's situation:

> My Roomba used to get caught under my TV. So, I was going to order those furniture risers, but they're not cheap. I had some very thick cardboard going spare, so I cut out some squares and put one under each leg. You can't even see the cardboard. It was a good result, and I saved lots of money.

In learning from other members like Steve, Sanja also asked for pictures and instructions on how she might improvise when it was necessary. Contrary to what is expected in interactions with robots, such as predictability and control (Hornecker *et al.*, 2020), consumers are

sometimes challenged to create their own "workarounds." A ramp in Amanda's kitchen is an example of this:

> Amanda: I have long hair and had a very bad experience with different brands of robots. Recently I found the Bravaa Jet M6 and thought it might be a good one—we don't have carpets. We call her Rosie, like in the Jetsons. We let it dry-mop every day and mop only once a week. Only a couple of weeks and I already love it. But it can't go over the large thresholds where we there is laminate. So, to enter the kitchen, we made a ramp out of wood shims glued to a cardboard. We polished and painted it to match our floors and it blends well.

Despite how creative some improvisations like Amanda's are, consumers still hanker after future affordances and the possibilities of new generations of Roomba, like a poop detector, better mapping of the floor, the ability to go up and downstairs, not getting tangled in wires, and other such features. Some are marked by the expression "for future reference." Rains' and Goode's posts are examples of this:

> Rains: So, my Roomba (S9+) got stuck. I wasn't home, but my mom went to my house to free it up for me. The app said "locate," but it won't show me where the Roomba was. I pressed "locate" but nothing. I could see it before though. I'm not sure how I got here. So, do you know how to see it on the map (for future reference)?
> Goode: Hi all! I just wanted to share an experience that might help you in the future. After I had routinely cleaned the unit (Roomba i8), there was an Error 68 code showing, which is a camera hardware issue. After multiple restarts, I decided to send it

in for a service, or return it. Cut to about 5 hours later and I performed a factory reset, and just to make sure everything was "fine," sure enough it worked like clockwork! So, if you have this problem, give the factory reset a shot.

To an extent, Rains, Goode, and other Roomba consumers rely on the community to shape their future interactions with their robots based on imaginative situations. Pink (2021) explains that such an exercise in imagination is essential for developing trust and positive feelings towards emerging technologies, like consumer robots.

Discussion

Drawing on the literature on HRI and an online brand community, in this paper we have investigated non-dyadic HRI. Unlike existing work in marketing and consumer research, we show that dyadic portrayals of HRI can be expanded to consider other actants that are relevant to the consumption experiences of consumer robots. Not only humans but also nonhumans, such as an online brand community (e.g., iRobot - Roomba), have a meaningful role to play in shaping the interactions between humans and robots. In this vein, in answering our research questions on the structural elements of HRI and the way consumers experience them, we show that different actants exert agency in different ways, at different times, and with different socio-technical arrangements. This happens and is based on an ongoing process of collective and individual learning that is sustained by the sub-processes of remembering, improvising, and imagining.

In this vein, the main theoretical contribution of our study relates to the conceptualization of HRI as a non-dyadic phenomenon. As found in extant research (e.g.,

Kim, So and Wirtz, 2022), HRI is conceptualized as a rational and transactional encounter between two entities (i.e., a human and a robot). However, as depicted in our data, different socio-technical arrangements enable different forms of interaction. As such, the present study moves theoretical debates on HRI from the individual level grounded in a purely psychological approach (see Blaurock *et al.*, 2022) to a more collective and sociocultural approach. Accordingly, the role of robots and what they can do in shaping interactions gain nuances that are worth inquiry. Currently, research on robots' agency is linked to responsibility and morality (Jacobs, Gazzaz and Kingstone, 2021; Henkel *et al.*, 2020). In many cases, these machines are equipped with sensors and cameras that can collect audio and video. Private moments, secret conversations, and the location of beloved ones are all capable of being captured, stored, analyzed, and used by the system so it can learn how to perform tasks better (Puntoni *et al.*, 2021). A problem that arises in this scenario is the responsibility that the manufacturer, robot, or consumer would have to face in the event of an accident or an undesired outcome (Gill, 2020). As we have seen in this research, since agency is distributed throughout the network, who is to blame? If the robot acts on its own, should it be punished? On what grounds (Gunkel, 2018)? Future research can explore the extent to which responsibility and morality can be conceptualized from a structural perspective (van der Wagen and Pieters, 2018) and how the shared morality of humans can be integrated into consumer robots (Zhu *et al.*, 2020).

As for the managerial implication, in alignment with some quotes previously shown, Hoyer *et al.* (2020) show that HRI has an emotional component linked to the anthropomorphization of a robot. In some cases, it is expected that robots will become true human companions, and increasingly perform human-like tasks. Technology, however, is closely tied to ideological discourses (Kozinets, 2008), which may backfire in the case of the

"super humanization" of the robot. As Belk (2022) notes, the "too human," the uncanny valley (Mori, 1970) is of great concern when it comes to consumer robots, since their likeness to humans can shift the consumer response from empathy to revulsion. As we have seen in this study, some Roomba owners have given their robots names, as they do their pets or children, and have apparently treated them likewise. Marketing managers, therefore, should consider the role of these consumer robots in the life of consumers (e.g., servants, companions, "pets") and their influence on consumption experiences (Pak, de Visser and Rovira, 2020). Concerning the latter, Schau and Akaka (2020) mention that emerging technologies, such as consumer robots, have a key role to play in shaping meaningful consumption journeys. Therefore, it is important for managers to consider, when possible, the context in which interaction with a robot might take place, be they a house, an office, or even public settings.

Conclusion

Interactions between consumers and their robots have a myriad of socio-technical arrangements that will have a tremendous impact on the consumer experience, and this offers several avenues for future research. Certainly, quite apart from robotic vacuum cleaners, the virtual assistants, chatbots, artificial, virtual, and mixed reality devices that are being gradually incorporated into consumers' daily activities will make research even more challenging, but ever more necessary. It is true that using robots is a convenience (Kaliyamurthy and Schau, 2019), they can increase our sense of self (Belk, 2016), and they may even improve and facilitate our fast-paced lives (Gretzel and Murphy, 2019). One last thought that is of the utmost importance concerns the downside of consumer robots. Both

researchers and managers must be aware of the dangers of an overreliance on these technologies and becoming addicted to them. They must also guard against any eventual dehumanization caused by the possibility of substituting humans for robots in specific contexts (Xiao and Kumar, 2019). Thus, it is important for future research to address the possible dark side of consumer robots and provide a comprehensive assessment of how emerging technologies will transform consumer interactions with robots and overall consumption experiences.

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