"There is a bit of grace missing": Understanding non-use of mobile robotic telepresence in a global technology company

Andriana Boudouraki
Stuart Reeves
Joel E. Fischer
firstname.lastname@nottingham.ac.uk
Mixed Reality Lab, School of Computer Science
University of Nottingham
Nottingham, UK

Sean Rintel
serintel@microsoft.com
Microsoft Research
Cambridge, UK

ABSTRACT

Mobile robotic telepresence technology may be a potential solution to hybrid communication as it allows remote attendees embodied movement in space. Yet, there is little exploration into how its affordances fit with the practices and needs of workplaces. This paper presents findings from interviews conducted following a discontinued deployment of telepresence robots at the offices of a global technology company. The findings indicate that in this case 1) The knowledge workers were equipped to manage hybrid work, 2) the robots offered limited perceived value, and 3) the robots were a poor fit to the knowledge workers' physically distributed workflows. Drawing workflows and non-use literature, we explore how features of the technology failed to align with the office's work practices and needs, and discuss the implications for evaluating the low use of robotic telepresence.

CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in HCI**.

KEYWORDS

videoconferncing, hybrid communication, non-use, workflows, accessibility

1 INTRODUCTION

The non-use of new technology is rarely reported in depth, however, much can be learned from such cases [4, 18]. Understanding non-use and adopting a non-binary view of success and failure can inform future implementations [5]. In this paper, we explore the non-use of Mobile Robotic telePresence (MRP), following a discontinued pilot of the technology in the offices of Microsoft Research. MRP promises a more immersive presence in hybrid spaces [16] through a relatively simple combination of a videoconferencing screen mounted on a remotely controlled robotic body on wheels (e.g., see Figure 1). A remote user is able to drive this system from a browser or a phone app, so that they can independently move in the environment of the meeting whilst having a video call. For this study, (non)users were exposed to the MRP system Double 3, by Double Robotics [23]. Adoption of MRP has always been limited, but, as with many technologies, costs and technical complexity of deployment are decreasing. That said we think a critical perspective on use and non-use of MRPs is warranted, reflecting on the many barriers to uptake in the context of a hybrid office.

Research in MRP has been ongoing since the development of early models [15, 20]. Studies claim positive reactions to the robots, with users reporting feeling a greater sense of presence, among other benefits more specific to the domains of use [6, 16, 17]. In workplaces, however, research has also identified a number of limitations. These include some difficulty driving and lack of feedback on one's own appearance and loudness[6, 17, 30]. Moreover, interactions can be awkward, with local users treating the remote user in disrespectful ways or with remote users struggling to enter or exit conversations graceful ways [17, 22] [1]. Still, there has been an increase in research on MRP in the recent years (e.g., [2, 12, 14, 32],) as the technology's mobility affordances may still offer potential solutions for hybrid spaces.

In this paper we follow-up on a deployment of MRPs that we had previously piloted at the offices of Microsoft Research in Cambridge [7]. After making the robots available to the employees for three months, for use around the office, the pilot was ended and use has been paused for the foreseeable future. To better understand this outcome, we interviewed employees who did and did not use the robots. The participants were asked about how they manage working in a hybrid style, as well as about their thoughts on using the robots for hybrid work. Using thematic analysis to examine our data, we describe three themes: 1) These knowledge workers are equipped to manage hybrid work, 2) The robots offer limited perceived value, 3) The robots are a poor fit to the knowledge workers' physically distributed workflows.

---

[1]In line with existing literature, we will use the term *remote user* for the person piloting the robot, *local environment* for the location where the robot is situated, and *local users* for the people interacting with the MRP in the local environment [16].

Figure 1: Double 2 Telepresence Robot, ©2023 Double Robotics, with permission.

2 RELATED WORK

2.1 Robotic telepresence in offices

Some studies in the early 2010s explored the use of MRP in offices. Tsui et al. explored the use of MRP for meetings and hallway conversations. They suggest that MRP systems are best suited for hub-spoke configurations (teams mostly working from one location with a one or few employees at a different location). They also found that it made little sense to use the robots for meetings which are mainly static, and that teams stopped using the robots when it interfered with accomplishing their work. With regards to hallway conversations, the robots were a poor substitute for in-person as they were too slow, had audio issues and participants were not able to walk and talk side by side. Venolia et al. also looked at the use of an Embodied Social Proxy system (not a robot, but a videoconferencing system dedicated to a remote user, mounted on a cart), to support hub-and-satellite teams (teams with one remote member) [31]. They found that the physical representation of the remote colleague helped overcome the barriers of distance, and led to more turn-taking and social engagement. They also found that the system's value depended on activities and users' social standing. Lee and Takayama's study reported overall positive receptions of the robots, which were mostly liked for enabling informal interactions [17]. The remote users were perceived as more committed

and available, and were able to achieve feelings of connection with the on-site employees. They also point out that driving was burdensome and caused delays, and discuss issues around establishing new, appropriate social norms. Takayama and Go, also looking at office deployments, found that people used a mix of human and non-human metaphors when referring to the MRPs, and argue that mismatch in how remote and on-site users orientate to the robots is a source of conflict [29]. More recently, Björnfot et al., looked at use in offices by non-technical users and report that users found the experience positive and felt present but also wished for more flexible movement and ways of gauging their appearance in the local environment [6]. These studies posit MRP as valuable for providing more presence and engagement at work, but also point to limitations. However, there is little exploration into the value of mobility in the office setting and how it fits into daily life at work.

2.2 Workflows and Work practices

Workflows research uses models that showcase how the different steps of work are ordered, with more recent and flexible approaches also taking into account the situated nature of work [10, 19]. It also looks at how work is done, what information or tools people are attending to and how they collaborate. Bowers et al. noted that this was done mostly in office contexts where the workflow tech was embedded in work software and the work itself. As such they applied this approach to a print shop, where the work done did not in itself involve the use of software. They found that introducing a workflow system in a workplace, even if it is external to the tools of the work and does not directly constrain or impose on the work, can lead to disruption if it is not made to fit in with the existing conduct of the work. Subsequent research in HCI and CSCW has further demonstrated the importance of examining work practices [28]. For example, Barrett et al.'s field studies of data centres showcase the role of collaboration, planning as well as the impact of the environment and tools in system administration work. And as Suchman's work points out, work technology needs to be examined in context and with consideration of the ways in which people adapt and respond to the constraints that it imposes [27]. Whilst we do not here develop a full workflow model, we draw on this research to more critically approach the issue of MRP use from the lens of how it fits into the organisation of work.

2.3 Non-use and design failure

The non-use perspective further calls us to examine underlying assumptions about how we understand technology adoption or failure. Not only is there more to how a person relates to technology beyond whether they use it or not, but there are different reasons for non-use which are just as insightful for understanding technology, such as active resistance, disenchantment, disenfranchisement and disinterest [25, 26]. Discussions on the topic also question the term, highlighting that non-use could be complete absence of use, selective use or a continually negotiated practice [5]. There is also considerable literature on systems failure within organisations highlighting the socially constructed nature of technology deployments; i.e. rather than the technology logically determining usage, views on its success and failure will vary among social groups [4]. Given this, we might also ask how success and failure are to be measured.

While some systems have clear quantitative criteria for what constitutes success, such as speed and accuracy, others do not. Gaver et al. argue that for a system aimed at supporting locally situated meaning making (and MRP may be considered one such system), more open ended and qualitative criteria are more apt.

3 APPROACH TO STUDYING MRP (NON-)USE

We piloted a deployment of telepresence robots at the offices of Microsoft Research, Cambridge [7], the follow-up of which we are documenting in this paper. Employees at Microsoft Research are engaged in various research projects on software development and HCI. Many work remotely, owing the international reach of the organisation. On-site employees are also able to work from home certain days of the week, further normalising remote working. For our deployment, we provided 5 Double 3 telepresence robots [23] to the employees for a period of three months as a way to support them with hybrid work and encourage participation in office activities.

Adoption of the robots was lower than we expected. Several people expressed interest but then never used them. Two teams used the robots on a semi-regular basis (one used them for weekly meetings, the other whenever someone was working remotely). Three fully remote employees signed up and used the robots to have casual, social interactions with their on-site colleagues, but gave up after one, two or five 'visits', saying that they had no opportunities to use the robot or that it did not work very well. Given the low adoption and some emerging security concerns, the company decided to discontinue the project.

This left us with a useful case study in examining the limited use of telepresence robots; something rarely looked at. We collected various kinds of data for this study from the start, so we were well-placed to seek to understand the issue.

3.1 Participants

Participants for this study were recruited via an email that was sent to all employees working at that particular office of the company. The email specifically stated that people who did not use the robots were also invited to participate. The sample consists of seven participants who were interviewed individually, and one team of five (ID no. 8) who were interviewed together as a group (See table 1). Overall, we had 12 participants (7 male, 5 female, ages 30-45). Participant 6 used the robots during the lock-down periods, before the pilot deployment, as a way to check on equipment in the office without coming into contact with other people. From the team of five (ID no. 8), one member used the robot for weekly meetings whenever she worked from home, and another member used it a couple of times to remotely attend a team workshop.

3.2 Procedure

Except for Participants 6 and 8, who were interviewed in person during the pilot deployment, the rest of the interviews were conducted online via Microsoft Teams within two months after the end of the pilot. The interviews lasted 30 minutes, to facilitate participants fitting them into to their busy schedules. The interviews were recorded and transcribed for analysis.

To establish context, participants were asked to describe what their work days look like and how they manage online communication and collaboration with their colleagues. They were also asked how they feel about hybrid work and whether it poses any challenges for them. Then, the participants were asked what they knew about the robots (to see how they perceived the robots and whether they had an accurate understanding of them). Participants who had used the robots were then asked about how they used the robots and what they thought of them. Then participants were more specifically asked to explain reasons why they didn't use or stopped using the robots. After giving their initial answers, they were asked whether they would use the robots provided that the issues they brought up were solved, as well as whether they would use them in other contexts (for e.g., at a conference or social event). Finally they were probed to discuss whether the physical presence and the mobility that the robots provided were relevant in how they conducted their hybrid interactions.

3.3 Analysis

We applied a qualitative approach in analysing the transcribed interviews. Specifically, we used Thematic Analysis (TA) [9]; a structured method for identifying patterns of meaning in qualitative data by coding data items with meaningful labels, grouping the codes into themes, and iteratively reviewing the themes to ensure they accurately represent the data set. Having spent time at the site whilst running the preceding deployment, we also bring our own experiences and knowledge of MRP when interpreting the data.

Our aim in this study was to understand why people did not opt to use the robots more, in terms of the practical realities of hybrid office life. The analysis is largely data-driven (inductive) rather than theory driven (deductive). In line with that, although we interpret the data we also report on the participants' more surface level answers, combining the semantic (descriptive) and latent (interpretive) approaches to TA.

4 USE AND NON-USE OF TELEPRESENCE ROBOTS

We present three themes; 1) These knowledge workers are equipped to manage hybrid work, 2) the robots offer limited perceived value, 3) the robots are a poor fit to the knowledge workers' physically distributed workflows. The first theme pertains to the broader context within which the participants operate. The second two themes focus on the participants' accounts for their low use or non-use of the robots.

4.1 These knowledge workers are equipped to manage hybrid work

Participants of this study (knowledge workers) were already well equipped to handle hybrid and remote work in terms of resources and strategies. This seems obvious in retrospect but contradicted our anticipations of potential use.

4.1.1 Knowledge workers are capable of managing hybrid work. The participants were initially asked to describe how they conduct their work. All of them tend to work with physically distributed teams or with colleagues who work in a flexible way (some days on-site/

Table 1: Interview Participants

ID	Work style	Use
1	on-site/flexible	Used weekly as local user, used once as remote user
2	on-site/flexible	Used weekly as local user
3	on-site/flexible	Used twice as a local user
4	on-site/flexible	Used once as remote user
5	remote	Used five times as remote user
6	on-site/flexible	Used a few times as remote user during lock-down
7	remote	Never used the robots
8	Group; on-site/flexible	2 team members used the robots as remote users

some days working from home). Some had already been working in this way even before the Covid-19 pandemic. As such, they were very familiar with this way of working. They were aware that it can pose challenges for communication and productivity, and they actively structured their work with that in mind.

Participant 3: "So I'm very used to working with people who are not anywhere near me, and so I'm productive in that environment. But that's not the case for everyone. So I try and make sure that everyone I work with has the option to do what works for them."

They have already established routines and thought-out strategies around communicating and collaborating remotely. Most participants will have certain regularly occurring meetings for catching up with their colleagues, which happen over video conferencing. They will also have other remote interactions during their day, through a variety of media; video, chat, email or other tools (e.g., digital whiteboards).

Participant 3: "So we have a bunch of teams, channels, and also a few group chats which are a bit better for building communities around because it's a smallish group of people that are willing to share personal things that they wouldn't in an official project channel sort of setting."

Participant 7 further reported that they leave Microsoft Teams meeting calls running after the end of meetings to allow space for follow-up ad-hoc discussions. Other participants also described using different channels for different types of interactions. The participants are aware that different media are better suited for different types of interaction, and that different people and teams have different preferences, and they proactively create spaces to accommodate those various needs (such as chat for less formal topics and open-ended meetings for ad-hoc discussions). Beyond that, Participants 1 and 2, who work in a physical lab have adjusted their experiments to be accessible remotely, so that their fully remote colleague can also participate in the work without significant limitations. The participants' reports indicate not only that they have solutions in place to manage hybrid work, but also that they themselves put considerable thought and effort into those solutions.

4.1.2 Preferences depend on activity. When asked how they felt about their hybrid work situation, many of course expressed a preference for in-person interaction. However, this was not a strongly felt sentiment. The following quote by P. 2 reflects most participants' positions.

P. 2 : "Well, it's definitely not the same as the physical presence. I think it's much easier when everyone's physically present, because

it's easier to see also other things like body movement but it's not like it has been a huge obstacle in that we could not work remotely. It's just feels better if you can meet physically, I guess that's how I would put it."

This may in part have to do with the fact that they are quite competent at managing remote communication. As P. 4 says in the quote bellow, talking about using the chat to voice opinions during video-conferences, they also have workarounds for dealing with its limitations.

P. 4: "I don't really mind because there's always someone at least who's looking at the chat or doing something, so I tend to just use the chat to get [attention]"

Moreover, some participants followed their answers with caveats, saying that there are times when remote work also makes sense. Their preference depended on the type of activity or reason for the interaction, and for certain activities remote communication was even preferred. As the quote below suggests, keeping a meeting fully remote even when some attendees could have met in-person, allows all the workers to have access each to their own equipment, which can be beneficial for some types of work.

P. 1: "When we have meetings, if the people are in the office, I prefer at least to do it in person since they're already there. Not to do it over [Microsoft] Teams. But if you have one person who is on Teams, then we would do it. [...] Sometimes a couple of us come to the same office and one person is on Teams, and sometimes we are all on Teams and I think it depends on the on the topic. If it's debugging we share a screen, everyone looks at the screen. It might be easier to have your own screen because you have better visibility otherwise we are all crowding in front of a screen. But if we are brainstorming something, then it may be better to sit and just see each other."

P. 4 also claimed that when at least one person is remote, some might prefer to move the whole meeting to online, rather than have part of the team meet in person. This perhaps allows for more equal participation as everyone then has the same access to the meeting. At other times, remote and asynchronous methods might be preferred to avoid disrupting others' work, as P. 7 reports.

P. 7: "For a quick question to someone you know [...], I'd be hesitant to kind of physically go and... if I was in the office, if their door was closed, I probably wouldn't knock on the door and interrupt them. I'd be conscious. That's something that strikes me a great deal if I'm in the middle of something, so I probably tend to do some initial question via chat or email that could be handled asynchronously or ignored."

4.2 The robots offer limited perceived value

When asked what they thought about the robots and why they stopped using them, the participants gave a wide list of reasons, ranging from technical limitations to issues relating more to interpersonal interaction and participation.

4.2.1 Technical quality limitations. Poor audio quality was a common concern. Participants often compared it with the quality they got on their standard videoconferencing application, Microsoft Teams.

P. 8: "...whereas in the conference room, the audio I think made it challenging for a robot to be feasible in that like big conference room. So in the end I ended up just joining the room audio with no video. Uh, so I could listen to everything and see everyone, but they just couldn't see me on the giant screen."

The participants described these limitations within the context of interactions, and in doing so revealed how something like not being able to hear very well essentially renders an interaction impossible without resorting to other media.

P. 4: "Two people in person and then me on the robot. And they had a very fluid conversation with each other. But then, you know, every time I wanted to say something, if they didn't stop talking to give me time and so on, then it would immediately cut out one of us, and it was just very awkward."

Other technical quality complaints included the speed of the robot, difficulty driving, difficulty reading other screens through the robot, limited spatial awareness and the fact that the robot did not work on certain surfaces.

P. 1: "[...] one of the main issues was the speed of the robot. You know, you basically have to wait.[...] By the time the robot comes to the call, we are already there and we started discussing. [...] The robot was not able to sort of follow us, it was more like we have a little toddler and you kind of walk with the toddler. 'OK is it gonna fall, is it gonna get stuck?' and then you spend like 5 minutes getting it over there and five minutes getting the robot back. And it's a lot of worries."

4.2.2 Use requires effort. The limitations mentioned above introduced the need to put in considerable effort to use the technology, often on the part of local users.

P. 2: "We had multiple locations where I had to follow whoever was using the robot or others had to follow me to make sure that this will dock properly. Otherwise, I would get a message later saying I'm stuck. [...] Small things like that. But I think they make a big difference. [...] For us at least, we would be a lot more happy with using the robots if those were not there."

Indeed, using the robot involved a lot of reliance on help. This was described as an awkward experience that people would prefer to avoid, especially given that they had other options that worked well enough.

P. 2: "It's not the time so much, it is also a bit annoying having to call someone. You take them out of their work to, you know, 'I'm stuck. Come and help me.' [...] Ideally, I should be able to do it myself, otherwise I can find other ways of joining. It would actually be easier to say, 'Call me on Teams' if I want to be there, unless I can do it myself."

As the previous theme explored, these participants were aware that hybrid communication requires some effort, and were on other occasions willing to do that for the benefit of their teams. In the case of the robots however, they expressed more discontent.

4.2.3 Participation. Participants were still not sure if they would use the robots even if the technical issues were fixed (such as better audio and video quality, easier driving, less lagging, solutions for doors and changing floors). More serious limitations were hindering use.

First of all, the robots did not allow for equal participation in local, physical activities over and above what other media already provided. When accounting for issues with the robots, the participants often brought up the fact that they needed to use Teams alongside, not only because the robots' audio was not good enough, but also in order to be able to take part in the work. As such, the robot did not provide a significant added value to that experience.

Many meetings involve looking or even working on documents. The visual acuity of the robot was not sufficient to allow looking at a screen through the robot's camera. Moreover, the documents would in any case be shared digitally.

P. 8: "I think in the in the meetings, when I was needing to lead those meetings. Then it was really useful. But I think that's changed now because I think we now, we now have something on screen during our meeting. [...] I think once you're there and there's stuff on screen, you can't really see it and it's a real pain to go. [...] we can share docs and things like that. But then why are you on the robot, right? Because you're just looking at a doc anyways."

Participants also brought up not being able to do things in the environment. For physical activities, such as drawing on a whiteboard or working in a lab, the robot still did not allow the remote user to do much. When attending a physical activity via the RMP, the remote users were stuck in the role of an observer and at a disadvantage compared to the local users.

P. 3: "The kind of times when I want to be able to be in the same room to work with someone usually there's some physical thing that I want us to both interact with, like a whiteboard. And there, if anything, the robot is less helpful because if we have a Surface Hub and we're both on laptops or one of us is on the laptop with a touch screen remotely and the other one's got the Surface Hub, we can share a whiteboard. We can both draw on things. But if one of us has hands and the other one doesn't... But we're both in the same room. That doesn't work nearly as well."

In addition, in most meetings there would be more than one remote participant. In those cases, it made little sense to have some people join through videoconferencing while others join via a robot.

P. 6: "When I joined a meeting which was much more hybrid with several people on teams and several people in. [...] The robot I don't think added a lot of value to that. In fact it would have been better if I'd been in Teams and felt more inclusive actually within that hybrid environment, because there at least I'm on the same platform as a percentage of the rest of the attendees."

4.2.4 Graceful presence. The second important issue the users expressed beside limited participation was that the robots did not allow for more subtle forms of interaction, nor did they allow them to a have graceful presence.

Some participants compared the use of the robot to actions made when physically present. This may be because the physicality of the medium invites such comparisons, as well as because the situations where participants would have liked to use the robots are those not yet supported by their other channels, namely more social and spontaneous interactions, where the subtlety of non-verbal, in-person cues plays a big role. Actions in physical presence are quick and done without much thinking. On the robot, on the contrary, these are done a lot more slowly and less effectively

P. 1: "You know, if you're [in] the office, you see the whole thing. You quickly move left and right with your eye glance, and so it's not a mechanical move that takes time. You wanna look there and then you look there and you know [it's] an instantaneous thing.

The element of intentional action was also brought up. While the participants wanted to be able to express embodied cues in their interactions, a remote user has to consciously manipulate the robot to make it move, making the cue unnatural and ineffective. As these are not possible, the behavior of the remote user and the robot end up appearing abrupt and awkward.

P. 4: If I have to press a button to show curiosity, then it acts weird again."

The slow, mechanical actions of the robot also made it difficult for participants to gracefully enter and exit social situations. As P. 5 describes, not being able to gradually peak into a space and subtly look at what is going on makes it difficult to negotiate whether it is an appropriate moment to interrupt and have a "serendipitous" conversation.

P. 5: "When I walk around here, it's very easy to casually see who's in their office or not. [...] with the robot, you have to stare, otherwise you can't, you know, see properly [...] there is a bit of grace missing to act more like a human and where you can make out if someone is there and then maybe if you think you want to chat then OK."

Participants also felt very visible and noticeable on the robots.

P. 8: "Wasn't private. Once you're moving on a robot, everybody's looking at you."

P. 5 also reported avoiding using the MRP at time when he knew the office would be busy so as not be cause a disturbance.

Overall, the robots had technical quality limitations in comparison to other resources available to the participants. Their use also seemed to require more effort than participants were willing to put in (again in relation to other resources). But moreover, the limitations of the robots that really seemed to matter were those hindering equal participation in activities, and more graceful and intuitive interaction.

4.3 The robots are a poor fit to the knowledge workers' physically distributed workflows

As mentioned in the previous theme, MRP did not provide solutions for participation, furthermore it did not fit into employees' workflows.

4.3.1 Time.
As noted above, several participants brought up the speed of the robot. It takes time to drive it between different locations as well park it back to its dock at the end of use. The study participants often simply did not have this time to spend on something like this.

P. 8: "I don't know how this will change over the year to come. But I've gotten really in the habit of having zero minutes between meetings. And when you're in the office you know, time is a little bit more flexible because you can kind of see [...] 'so and so is coming and I'm just going toilet'. But if you're a robot, you don't have those same cues that everyone has. Yeah, so you're like 'Ohh, no. And now I'm late' "

Those who worked with people from different time zones had even less time, as the window of overlapping work hours with their colleagues was shorter. Generally, work at the company could be fast-paced, which did not fit with the slow nature of robotic telepresence.

P. 7: "Meetings tend to be somewhat chaotic and reorganised at short.notice. Then physical locations, when booked, tend to be spread out around the building. And my schedule, as I showed you, tends to be back-to-back. So you know, being able to switch from one to the next with Teams is convenient for those shifts as as well."

4.3.2 Physical Space.
Apart from lack of time, presence in physical space was not very relevant to participants. In part this was because they were used to communication through videoconferencing. Physical presence was not needed in order to pay attention to someone, as it might have been in the past.

P. 1: "It's not relevant anymore. Maybe it would have been three years ago. But I'm so used to it now [...] I work a lot with the US, with the West Coast. So I have many meetings from 3:00 PM sometimes to 10-11 PM on Teams. So, I'm so used to it now that [...]"

Moreover, their work did not really happen in physical space. Often there was not one single physical location on which to meet, as the team members were physically distributed over several locations.

P. 7: "So, there's often not been enough physical place that people are collaborating in. It's often been around documents and code and discussions. [...] I think much of our team is split over a couple of sites already and there are some people in the Redmond area, some the Mountain View area and some on the East Coast. So, most peoples' schedules tended to be joining these Teams meetings as I mentioned often audio only and then just kind of going from one to the next."

Furthermore, the technology brings more focus to the physical space but does not make participating in the physical space easier. Whilst attempting to improve inclusively, it may in fact be doing the opposite.

P.5: "It's interesting because it assumes that the people that you want to meet are actually in the office. [...] You know, in a way, advocating for the robot to enable that, pushes a bit more to exclude other people who are fully remote. You know, because you would focus more on having real life interactions with office people, but maybe then you don't focus so much on the other ones."

4.4 More meaningful solutions

The participants did express a need for more meaningful solutions, especially for more social interactions and casual encounters, where it was felt that the existing tools do not do fulfill their needs but neither did the robots.

P. 4: "People tried doing just like a 'hallway channel' and then you can sit in that. But like you don't go out and stand in the hallway and wait for people to come by. So, always [hybrid] chills are simply weird. [...] On the one hand, if robot became really common and was

just a way... like if you had other reasons to move around the office, you would actually bump into people and it would be nice. But I'm still kind of wondering if [the robots] would do that because they seem very purposeful. If you go on the robot, you go to your meeting and you park the robot. Because otherwise it's like that weird hallway channel that you go in the robot in the hopes of casually walking around and meeting people"

Existing organizational communication tools involve a certain intentionality which does not seem to be conducive to casual and social interactions. Whilst for a work-related matter it may be acceptable and effective to approach others purposefully and directly, social interactions rely more on subtler and serendipitous cues such as making eye contact with someone while passing by their office. Adding movement to video conferencing seems like a "quick fix" that does not really address this issue.

P. 5: "Well, I think. You know, solving this issue of casual encounters is tricky and you know, using robots is just probably one of many ways to do this. [...] I would like to see more functionality also in applications like Teams. To have casual hangout rooms or so. Because at the moment everything is a scheduled meeting and you have the group chats, but then it's not easy to actually hang out with people because the moment you press a button to start a call, then everyone gets notified [...]. You would not do it because it's too disruptive, too invasive [...]. You need improvements on all fronts. And it's not just having a robot as a kind of quick fix. It's one feature of the whole problem I think."

5 DISCUSSION

Our interviews showed that for knowledge workers—while clearly skilled at managing hybrid work and possessing a variety of resources at their disposal—telepresence robots offered limited value broadly in terms of allowing for effective interaction and hybrid participation. Tied up with this was the simple fact that telepresence robots did not fit well with the ingrained workflows of the hybrid office.

5.1 Considering MRP within hybrid work practices and needs

To assess the value of MRP technologies at workplaces then, it is worth noting the affordances and features of the medium against the needs and work practices of the given workspace. As Bowers et al.'s work showed, technology that is not aligned with workflows, even if external to the tools of work, can be disruptive.

While we have not conducted a full examination of 'workflows' at the company, the authors' roles in the deployment (and in one case personal experience as an employee of the company), coupled with the interviews, provide insights that should be taken into account when thinking about future telepresence technology implementations. We detail these in the following.

5.1.1 Knowledge work in this case study. A majority of the work and work related communication is done digitally. Employees at the company work on the research and development of software and hardware. Some of their work involves manipulating physical prototypes but the majority (such as coding, data analysis, writing reports) is done digitally. For the most part, the employees use Microsoft Teams for meetings, chatting and file sharing, along with other digital media. Meetings also often involve collaborative work on digital material (e.g., debugging code, producing a presentation deck), and require that meeting attendees are able to view and edit this material during the meeting. There is, however, some work being done in physical space, such as whiteboarding sessions or laboratory work, and while the employees are finding ways to allow for remote access to those, there may still be space for better solutions. That said, MRP sits in an uncomfortable space between remote and in-person, providing a poor substitute for each rather than a valuable third option.

Moreover, people within teams tend to be distributed across various locations and time zones. The participants had colleagues based in more than one or two different physical locations and/or who had different schedules in terms of work from home and on-site days, as well as with some who were fully remote. They might also work with people from other companies or agencies. This requires careful planning of meetings so as to fit in the different time zones and preferences, leaving the employees with little time in-between meetings (which to use for driving the MRP around the office). In addition, this, in conjunction with the earlier point about work being done mostly digitally, renders the physical space less relevant. As everyone is in different locations, there is not one specific physical environment that everyone is keen to be present in. Tsui et al. and Venolia et al. talk about the usefulness of telepresence technology for hub-and-satellite/hub-and-spoke configurations, but this was not a predominant configuration in our present case study [30, 31]. Rather many teams could be more akin to hub-to-hub or fully decentralised configurations.

5.1.2 Worker needs within a hybrid workflow: participation and graceful presence. Although very adept at managing remote and hybrid collaboration, from the interviews we also see that the workers are faced with two distinct needs: equal participation and graceful presence.

Beside the technological limitations of the robots, when it really came down to pinpointing why the technology was rejected, participants talked about not being able to remotely do what their local colleagues were doing. In cases where activities take place in the physical environment, there is an assumption or expectation that mobile robotic telepresence might help. However, the activities that were described, whiteboarding or running lab experiments, require not only to be able to look around with ease and have clear visual acuity (which the robots did not allow) but to also be able to do things in that setting; to draw, point or manipulate objects. In such activities, when joining via the robots, the remote users became mere 'spectators'. Instead if the whole activity was moved to an online digital medium, even if not ideal, everyone could participate equally; this was preferred. In addition, in meetings (that is, in activities where physical space is less relevant and the main task is discussion or document editing) participation via the robots was also not equal. While the robot might have given the remote user some sense of presence by allowing them to move in the room and command attention, they still needed to use other media, such as Microsoft Teams, in order to be able to hear what is happening and take part in the work.

Beyond action-oriented participation, the interviewees also felt that the MRP did not support them in expressing themselves and

engaging in unstructured, social interactions with subtlety and grace. The participants expressed a need for better solutions for social interactions. While they were able to find solutions around remote and hybrid work, it was harder to do so for informal and social interactions. And even within work, being able to express themselves more intuitively and naturally would be appreciated. The workarounds for participation that make sense for work, such as having an agenda, hand-raising and typing comments on a chat along side a meeting call, were thought to make social hang outs feel forced. Moreover, what the existing media lacked were the embodied cues that make an interaction flow more naturally by allowing members to mutually negotiate beginnings, endings and turn-taking in managing asymmetries [24]. However, although the robots allowed for movement, this was perhaps too inflexible, slow and intentional to allow for this either. And whilst the telepresence robots have been reported to help with informal interactions [17], participants in this study felt that wondering around the office with the robot in order to have chance encounters was also forced and contradictory. Interjecting into conversations also did not work, as it happened abruptly and the audio feedback cut off when the remote user spoke.

Ultimately whilst MRP technologies solve the issue of movement in space, they did not provide solutions to the actual needs of employees in this case.

5.2 Framing success with low use

It is not clearly understood what may be considered a successful implementation of MRP. In the current case, the deployment was discontinued because of low use as well as other concerns. Quantitative measures may be used, such as hours of use, number of users, ratings of user satisfaction as well as more qualitative measures such as interviews and field studies. But just what are the relevant measures?

5.2.1 Reference comparisons. When evaluating MRP, it is important that we understand what comparisons are being made. Studies of MRP often report that users feel present but do not specify in relation to what. In our interviews the participants, without being asked to, systematically compared the capabilities of the robots to those of other digital media, predominantly Microsoft Teams. However this was not with regards to presence, but to account for why they found using Teams easier than using the robots. It may be argued that videoconferencing and remote collaboration technologies have progressed enough for them to be the baseline that MRP needs to catch up to, rather than the other way around. Another dimension to that, is the amount of Work [13] required to make videoconferencing systems work—which although not minimal may be significantly less troublesome than the work of making MRP work. At the same time, our participants also made comparisons to the in-person experiences of interaction and perception, when describing the robots' lack of subtlety in social interactions. Gaver et al. propose *references* to other media and experiences as a dimension of understanding design failure [11]. Whilst use of references can suggest that people engage with a system and integrate it into their lives, it can also be a useful way of understanding the negative aspects of it —as was more the case in this study. Further it can highlight how people orient to the technology. In this case,

people attempted to use it as another solution to videoconferencing as well as, as a replacement for in-person presence.

5.2.2 Infrequent use is okay. It could be that sporadic use is 'enough'. Features of robotic telepresence technology may not perfectly align with the daily work practices of an office but may, nonetheless, be useful in less frequent special events, such as remotely attending a demo, supervising a workshop or checking on equipment. As work on non-use points out, use and non-use are not binary absolutes [5]. MRPs may allow remote colleagues to visit the office every now and then (e.g., tour the office as part of onboarding, or occasionally when they have the time), even if they opt for other media in their daily routines; that need not be considered a failure. Another possibility may be that only one or few employees of the company choose to use it (perhaps people who happen to be in hub-and-spoke teams, or who's specific work tasks align with the robots' capabilities). Such use may also be worthwhile and considered a successful implementation. Indeed, more constructionist approaches to systems (e.g., Pinch and Bijker, Wilson and Howcroft) point out that the terms 'success' and 'failure' are vague with regards to who sees them as such, and we should rather focus on addressing the view of the relevant social group. We may draw on the paradigm of success applied to accessibility features, such as a wheelchair ramp, where even if it is not used on a regular daily basis it is still beneficial to have it.

5.3 Responsible Research and Innovation

MRP is intended to enable people in remote locations to project their presence in a physical space and engage with people in it. In that way it is a potential tool for inclusion and accessibility. Following the RRI framework, [1] we anticipate that other MRP deployments in offices might similarly find that the technology is not used widely or frequently, and that this might result in less interest in future use, research and design improvements. The implication of our present research is that when it comes to implementation of novel telepresence technologies, more initial work should be done to properly understand whether and how those technologies address existing needs. Our case study was an example where the technology did not add value. Indeed, for truly responsible innovation, we should first ask, "Is the creation and use of a new product actually helpful?" and we have to be okay with the answer sometimes being "No.". Still, considering MRP's potential for accessibility, we don't advocate for rejecting the technology altogether, but instead, for expanding the research to further explore it from that angle and for adopting more suitable definitions of success and failure. As such, it is worth engaging with a more diverse group of users and a wider range of applications. And given the cost of the technology, researchers should take steps in making it accessible to those potential users.

5.4 Limitations

There are certain limitations to our study, with regards to explaining non-use and low use of robotic telepresence. First, this research did not account for factors beyond those directly relating to the users and their work. In the broader scope of the adoption of the technology there are also managerial, organisational and financial factors, such as decisions made by team managers, HR and IT with

regards to the purchasing and implementation of work technology. In addition, our study looks at only one organisation and a few people in it. It is worth pursuing more research in different organisations and other settings to gain a more complete understanding of the issue. Beyond that, there is an inherent challenge in studying non-use. Whilst we advertised to non-users, it was perhaps natural that the people interested in talking to us about the technology were mostly the people who had been interested in testing it. Moreover, we were limited to interview data, as it is not possible to conduct field observations of non-use, and as such it is possible that there are more reasons which were not captured by self-reported accounts or that by directly asking the participants we enticed them to come up with explanations.

6 CONCLUSION

Following a discontinued pilot deployment of MRP at the offices of Microsoft Research, we interviewed a selection of users and non-users to better understand people's reasons for (not) using the medium. We found that the knowledge workers of this study were already equipped and capable of managing the challenges of working in distributed teams. We also found that the MRP system did not offer a significant benefit over and above other channels, and particularly fell short at supporting equal participation in physical hybrid activities and graceful interaction in social scenarios. Finally, the system did not fit well within the workflows of this specific hybrid office, as the employees were not able to allocate the time required to use the robot between calls and as the physical space, on which MRP inherently operates, was not relevant for the majority of interactions.

More work is needed to properly understand the role and value of MRP in workplaces. Ultimately, our aim in this line of research, and the approach we wish to advocate for, was not to find ways of increasing use, but to understand what is actually beneficial and what is not. Our study could be seen as an example against the technological determinism that sees technology developing before considering human social structures. Future work on telepresence technologies for hybrid work would benefit from more closely examining the workplace's work practices and ensuring that the features of the technology in question align to those practices. Drawing on workflow research, we show that it is beneficial to understand where and how the work is done, in terms of space, time and tools. In addition, our interviews show that workers have a very good understanding of the needs and challenges that come with collaborating in hybrid modes, and that they may have significant expertise and motivation to find solutions. Work in the area would thus benefit greatly from more closely understanding practices and involving users in design process from earlier stages. We hope that this case study serves as a reminder to our industry that people want and deserve meaningful solutions.

ACKNOWLEDGMENTS

REFERENCES

[1] [n. d.]. Framework for Responsible Research and Innovation. https://www.ukri.org/about-us/epsrc/our-policies-and-standards/framework-for-responsible-innovation/

[2] Luis Almeida, Paulo Menezes, and Jorge Dias. 2022. Telepresence Social Robotics towards Co-Presence: A Review. *Applied Sciences* 12, 11 (2022), 5557.

[3] Rob Barrett, Eser Kandogan, Paul P Maglio, Eben M Haber, Leila A Takayama, and Madhu Prabaker. 2004. Field studies of computer system administrators: analysis of system management tools and practices. In *Proceedings of the 2004 ACM conference on Computer supported cooperative work*. 388–395.

[4] Eszter Bartis and Nathalie Mitev. 2008. A multiple narrative approach to information systems failure: a successful system that failed. *European Journal of Information Systems* 17 (2008), 112–124.

[5] Eric PS Baumer, Jenna Burrell, Morgan G Ames, Jed R Brubaker, and Paul Dourish. 2015. On the importance and implications of studying technology non-use. *interactions* 22, 2 (2015), 52–56.

[6] Patrik Björnfot, Joakim Bergqvist, and Victor Kaptelinin. 2018. Non-technical users' first encounters with a robotic telepresence technology: an empirical study of office workers. *Paladyn, Journal of Behavioral Robotics* 9, 1 (2018), 307–322.

[7] Andriana Boudouraki, Joel E Fischer, Stuart Reeves, and Sean Rintel. 2023. Your mileage may vary: Case study of a robotic telepresence pilot roll-out for a hybrid knowledge work organisation. In *Extended Abstracts of the 2023 CHI Conference on Human Factors in Computing Systems*. 1–7.

[8] John Bowers, Graham Button, and Wes Sharrock. 1995. Workflow from within and without: Technology and cooperative work on the print industry shopfloor. In *Proceedings of the Fourth European Conference on Computer-Supported Cooperative Work ECSCW'95: 10–14 September, 1995, Stockholm, Sweden*. Springer, 51–66.

[9] Virginia Braun and Victoria Clarke. 2006. Using thematic analysis in psychology. *Qualitative research in psychology* 3, 2 (2006), 77–101.

[10] Clarence A Ellis, Simon J Gibbs, and Gail Rein. 1991. Groupware: some issues and experiences. *Commun. ACM* 34, 1 (1991), 39–58.

[11] William Gaver, John Bowers, Tobie Kerridge, Andy Boucher, and Nadine Jarvis. 2009. Anatomy of a failure: how we knew when our design went wrong, and what we learned from it. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. 2213–2222.

[12] Ian Gonsher, Yuxin Han, Karthik Desingh, and Aaron Gokaslan. 2022. Prototyping Mixed Reality Large Screen Mobile Telepresence Robots. In *5th International Workshop on Virtual, Augmented, and Mixed Reality for HRI*.

[13] Jonathan Grudin. 1988. Why CSCW applications fail: problems in the design and evaluation of organizational interfaces. In *Proceedings of the 1988 ACM conference on Computer-supported cooperative work*. 85–93.

[14] Teppo Jakonen and Heidi Jauni. 2022. Telepresent Agency: Remote Participation in Hybrid Language Classrooms via a Telepresence Robot. In *New Materialist Explorations into Language Education*. Springer International Publishing Cham, 21–38.

[15] Norman P Jouppi. 2002. First steps towards mutually-immersive mobile telepresence. In *Proceedings of the 2002 ACM conference on Computer supported cooperative work*. 354–363.

[16] Annica Kristoffersson, Silvia Coradeschi, and Amy Loutfi. 2013. A review of mobile robotic telepresence. *Advances in Human-Computer Interaction* 2013 (2013), 3–3.

[17] Min Kyung Lee and Leila Takayama. 2011. " Now, i have a body" uses and social norms for mobile remote presence in the workplace. In *Proceedings of the SIGCHI conference on human factors in computing systems*. 33–42.

[18] Nathalie Mitev. 2000. Toward Social Constructivist Understandings of IS Success and Failure: Introducing a New Computerized Reservation System. *ICIS 2000 Proceedings* (2000), 9.

[19] Gary J Nutt. 1996. The evolution towards flexible workflow systems. *Distributed Systems Engineering* 3, 4 (1996), 276.

[20] Eric Paulos and John Canny. 1998. PRoP: Personal roving presence. In *Proceedings of the SIGCHI conference on Human factors in computing systems*. 296–303.

[21] Trevor J Pinch and Wiebe E Bijker. 1984. The social construction of facts and artefacts: Or how the sociology of science and the sociology of technology might benefit each other. *Social studies of science* 14, 3 (1984), 399–441.

[22] Irene Rae and Carman Neustaedter. 2017. Robotic telepresence at scale. In *Proceedings of the 2017 chi conference on human factors in computing systems*. 313–324.

[23] Double Robotics. 2022. *Double Robotics - Telepresence Robots for the Hybrid Office*. https://www.doublerobotics.com

[24] Banu Saatçi, Roman Rädle, Sean Rintel, Kenton O'Hara, and Clemens Nylandsted Klokmose. 2019. Hybrid Meetings in the Modern Workplace: Stories of Success and Failure. In *Collaboration Technologies and Social Computing*, Hideyuki Nakanishi, Hironori Egi, Irene-Angelica Chounta, Hideyuki Takada, Satoshi Ichimura, and Ulrich Hoppe (Eds.). Springer International Publishing, Cham, 45–61.

[25] Christine Satchell and Paul Dourish. 2009. Beyond the user: use and non-use in HCI. In *Proceedings of the 21st annual conference of the Australian computer-human*

interaction special interest group: Design: Open 24/7. 9–16.

[26] Neil Selwyn. 2003. Apart from technology: understanding people's non-use of information and communication technologies in everyday life. *Technology in society* 25, 1 (2003), 99–116.

[27] Lucy A Suchman. 1987. *Plans and situated actions: The problem of human-machine communication.* Cambridge university press.

[28] Margaret H. Szymanski and Jack Whalen (Eds.). 2011. *Making Work Visible: Ethnographically Grounded Case Studies of Work Practice.* Cambridge University Press.

[29] Leila Takayama and Janet Go. 2012. Mixing metaphors in mobile remote presence. In *Proceedings of the acm 2012 conference on computer supported cooperative work.* 495–504.

[30] Katherine M Tsui, Munjal Desai, Holly A Yanco, and Chris Uhlik. 2011. Exploring use cases for telepresence robots. In *Proceedings of the 6th international conference on Human-robot interaction.* 11–18.

[31] Gina Venolia, John Tang, Ruy Cervantes, Sara Bly, George Robertson, Bongshin Lee, and Kori Inkpen. 2010. Embodied social proxy: mediating interpersonal connection in hub-and-satellite teams. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems.* 1049–1058.

[32] Sirje Virkus, Janika Leoste, Kristel Marmor, Tiina Kasuk, and Aleksei Talisainen. 2023. Telepresence robots from the perspective of psychology and educational sciences. *Information and Learning Sciences* ahead-of-print (2023).

[33] Melanie Wilson and Debra Howcroft. 2002. Re-conceptualising failure: social shaping meets IS research. *European Journal of Information Systems* 11, 4 (2002), 236–250.