Walking Your Robot Dog: Experiences and Lessons Learned

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***Abstract*— Walking is an integral part of daily human lives which also has a great influence on happiness and wellbeing. Walking with a dog companion is one of the most popular forms of recreational walking that has similar benefits. The recent development of mobile zoomorphic robots, especially robot dogs has opened up new opportunities in the landscape of walking with companions. This led us to investigate how such robots can accompany humans in walking, and how the mobility and behavior of robots in a daily-life walking scenario affect humans' walking experience. We interviewed nine participants who took a 15–20-minute walk with a companion robot around a university campus, to understand how diverse walking behaviors of a companion robot influence their perceived experiences. We have generated four key themes through thematic analysis. They imply that affective relationalities between humans and robots can build intimacy and empathy, whereas personal space and physical proximity need to be thought carefully to ensure interaction comfort and spontaneity. Additionally, the robot influenced people's self-reflection and social values refraining them from enjoying an unknown experience, while ambiguity in communication led to less confidence and trust.**

I. Introduction

The integration of robots into daily lives is increasing rapidly, spearheaded by their social capabilities, users' experience while co-existing with them, and the companionship aspects of robots [1]. Companion robots, characterized by their ability to engage physically, socially, emotionally, and safely with humans, play multifaceted roles across diverse contexts [2], such as daily life assistants, emotional support systems, healthcare companions, mediators of social interaction, learning companions, and companions in entertainment. Robots are now being developed for real-life scenarios as daily life domestic companions, for example, Samsung has introduced their home companion robot Ballie which can provide a helping hand to users in many indoor situations [3]. It is capable of understanding usage patterns and social habits to provide smarter, more personalized interactions. Sony has developed Poiq, a robot friend that uses personalization and emotional cues to engage in social interactions with its users [4]. Robots that can accompany humans in both indoor and outdoor scenarios have been developed, such as [5]. Gita is a cargo-carrying robot that can follow its human counterpart autonomously while maintaining pedestrian etiquette. The success of these robots hinges on factors such as social behavior, collaboration, empathy, and trust, all of which contribute to the creation of a meaningful and positive relationship between humans and robots [2]. Companion robots are capable of introducing social presence [6], empathy [7], contextual behavior [8], and co-existence [9] which in turn help them connect to humans in a more personalized way, making the interaction more meaningful. Being a daily life companion includes robots capable of having contextual conversations, understanding social cues, accompanying in tasks, and being emotionally present for their human companions [10].

Walking and being mobile is an integral part of human lives and it can take many forms depending on the context and company. While walking alone fosters mindfulness, exploration, and creativity [11], walking with a companion has the remarkable ability to transform and elevate the overall walking experience in several ways. Firstly, companionship adds an element of enjoyment and socialization to the activity [12]. Engaging in an interaction or a conversation with a companion, whether it's a friend, family member, or pet dog, can make the walk more pleasant and stimulating. It provides an opportunity to share thoughts, stories, and experiences, fostering deeper connections and strengthening relationships [12]. Additionally, having a walking companion might enhance feelings of safety and security, particularly during explorative walks in unfamiliar or isolated areas. Furthermore, walking with a companion, e.g., a dog often serves as a source of motivation and accountability, especially when it comes to maintaining activity goals [13]. Overall, the presence of a companion enriches the walking experience, making it not only a physical activity but also a social and emotional one.

While there are so many talks and speculations about how robots might be able to accompany humans in daily lives, we curiously wonder, *would robots be able to accompany humans in daily walking activities? And if so, how would humans feel being accompanied by robots on their daily walks? How would humans experience walking with a robot companion?* Although there are many investigations and research about turning robots into "individuals" or "beings" in human societies [14], [15], humans' perspectives on such applications remain inconclusive. Understanding how humans experience walking with robots on a daily basis might be a step in the direction of understanding how

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mobility in daily human-robot companionship affects their relationship.

We have designed a qualitative study through which we want to answer the aforementioned questions. To be more specific, firstly, we aim to investigate how the different walking and movement behaviors of a robot influence the perceived walking experience as well as the perception of the robots. Secondly, we aim to understand the walking dynamics and how those dynamics affect the overall walking experience. Walking dynamics in this context refers to how the human and the robot influence each other's walking behavior, and how they coordinate their walking in relation to each other. We invited nine participants to take a walk with a robot and interviewed them afterward to understand their walking experience. The interviews were transcribed and analyzed through thematic analysis [16], which resulted in four themes that reveal multiple facets of human-robot walking companionship.

II. METHOD

This section provides a detailed overview of the study including the participants, procedure, data collection, and analysis.

A. Participants

Nine participants (out of 13 interested) were recruited through advertising via the university's intranet. Interested participants completed a Google form that included questions about their age range, gender identity, country of origin, familiarity with robots, and their frequency of taking walks. Five of them were women and four were men while their age ranged from 18 to 30. One participant worked at the university while the other eight were students. The participants were selected to introduce as much cultural diversity as possible and all nine participants represented a different nation. They were from Pakistan, Guatemala, South Africa, Russia, Denmark, The Netherlands, Finland, Iran, and Hungary. All participants reported taking walks at least two times per week and five of them reported walking at least four times per week. All of them have either seen or interacted with a robot before, but none reported walking with a robot, so this was the first-time experience of walking with a robot for all of them. Only one participant reported having a dog as a pet. Fig. 1 shows a participant walking with the companion robot. The Boston Dynamics robot dog, Spot was used in this study as the walking companion. Its capabilities include dynamic mobility, allowing Spot to climb stairs, and traverse challenging terrains, which makes it capable of accompanying humans walking in different environments.

B. Procedure

Participants were asked to take a 15–20-minute walk around the university campus which included walking inside the building corridors, university fields, and roads around the university campus. Although there was an overall direction, there was not a strict route of walking since we wanted participants to be explorative throughout the study. Participants were asked to finish the walk in 20 minutes and go back inside to where they started the walk. The typical flow of the walk would thus be: starting inside the building, going out through the entrance, walking on the fields or taking the pedestrian roads around the building, and then coming back inside through the same entrance where the walk started.

Figure 1. A participant walking with the companion robot.

A Wizard of Oz method [17] was employed in this case as the robot was controlled using a tablet controller from a distance of at least 20 feet or six meters. The robot's walking, following, movements, and all other behaviors were simulated using the controller. Three types of walking were simulated during the walk, 1) following the participant, 2) walking side-by-side, and 3) leading the way. Two different walking types were also simulated: normal walking and hopping/jogging. Apart from these, some movement behaviors like leaning forward, leaning backward, and looking on the sides were simulated. All participants experienced all types of walking, however, there were no preset patterns or order to the simulations, and they were simulated when seemed appropriate. The simulations were also contextually and dynamically adjusted to how the participant reacted and interacted with the robot, for example, if the participant stopped at a place, the robot would stop as well and look around, and the robot would change its direction toward where the participant is heading. The first author acted as the controlling wizard and the participants were not explicitly told if and how the robot was controlled from a distance.

C. Data Collection

After walking, participants joined a semi-structured interview [18] session with the researchers where they were asked about their walking experience in detail. They were asked to summarize the overall experience, how walking with a robot is different from walking alone or with someone, what behaviors they noticed and how they influenced the walking, what the walking dynamics between them, the

positives and negatives of the experience, and finally how they would modify or improve the experience of walking with a robot. Additionally, participants were asked to share their prior expectations and compare the experience with that. To summarize, these questions helped us understand how the robot influenced walking (both positively and negatively), how the robot was perceived as a walking companion, and how this experience can be improved. The interviews were audio-recorded with consent obtained from the participants.

D. Data Analysis

Recorded semi-structured interviews were transcribed using the MS Word dictation tool and then all transcription anomalies were corrected by the first author. The interviews were analyzed through a thematic analysis [16] process which included getting familiar with the data, applying codes to each quote, grouping codes to find topics, and then critically analyzing and combining topics into themes. Atlas.ti [19] software was used for the coding and topic generation process while Mural [20] was used for grouping and visualization of different themes. All authors contributed to the initial coding process and grouped all the codes into topics. The generated topics were then discussed among authors, and this resulted in finding topic groups, which were considered as themes. The theme generation process required three iterations through critical analysis and discussion between all the authors. After concrete themes were found, the first author gathered all the data connected to each theme and completed the analysis.

III. FINDINGS AND DISCUSSIONS

Four distinctive themes were found by analyzing the interview data through several iterations. As the primary findings of the study, those themes are discussed below along with the lessons learned from them.

A. Theme 1 - Affective Relationalities: Empathy, Care, and Intimacy

Participants' comments pointed out experiences that indicate the affective relationship they formed with the robot and compared it with a living being. Their experience indicates an empathic and emotional connection with the robot while the interaction felt like something they would have with someone or something more intimate. P1 said, "*I got a lot of positive emotions. I felt more comfortable than with a stranger, for example, because I knew that this is a safe experience*". The participants also felt that they could have intimacy with the robot in the sense that the robot would care for them. P1 mentioned that they would consider the robot as an extension of friends they can share private thoughts with, "*Sometimes friends have a lot going on in their own lives and you don't want to bother them with your own problems. In that case, I would share some of my private things with the robot*". P2 felt a connection with the robot and felt like talking to it, "*I think I found myself at some points also wanting to kind of talk to it.… Not necessarily a conversation, but yeah*". P2 mentioned that the robot had features that made it feel real, saying "*It's not a real thing, but it has those features. So, like, I think subconsciously I empathize with that and kind of see it as a little pet*". P4 compared the robot with a pet or small children and it had similar features that made them feel emotionally connected to the robot, "*But I think that if I had pets or children, it was somehow the same because they would do something similar*". P9 let the robot be comfortable in what it was doing and did not want it to get hurt in the process, "*I was kind of making sure that it stays safe and just kind of at some point was kind of falling back a bit just to kind of let it, I guess get a sense of the surroundings. Yeah, I think I didn't want it to get hurt*". P9 also mentions that they found similarities with a pet dog and treated the robot the same way they usually treat their pet, "*It was like a dog, I would say it felt more like a dog especially like when I was walking a bit in front of it and we were taking turns, I just had to look, look around the corner like if there's someone, if there are people in the way or objects that it could bump into*". The robot's body resembled a pet-like appearance whereas its behaviors were similar to those of pets or children, both of which are cared for by humans a lot. Participants felt empathy and developed intimacy towards the robot because of its appearance and behavior which led to them caring for the robot. Consistent with previous research [21], [22] this implies that the robot's appearance and behavior are important aspects of building rapport, at least initially when the robot is relatively unknown.

Participants also reflected on more of the symbiotic relationship between humans and robots by mentioning how the robot might be able to complement human capabilities. P4 explained, "*Maybe it's somehow hard for me to just bring my phone out and look the location because it's cold, so it would be again good that you just give the robot the location and it goes, and you just follow*". P8 mentioned that the robot could help find a safer path that leads to safer interaction, "*For somebody who's old and a bit more fragile, the companion robot could help them find the least accident-prone path for them*". P8 felt that the robot exerted the qualities of a companion rather than just being there as another object which points to an affective symbiotic relationship with emotional connectedness, "*I felt more that it was accompanying me rather than simply being there because it was, I don't know how to describe it really. Just it being right next to you and following the same speed, that felt more reassuring*". P9 also perceived the robot as something alive and had its own mind/desires, "*It really felt like it was alive*" and P6 emphasized that the robot had its own personality when it comes to making decisions, saying, "*I liked it that it was not like literally just following me, but like the robot had like its own desires of where to go or like*

how to walk". While there is a lot of positivity towards the robot having its own mind and desires, there are also suggestions of a more commanding-obeying relationship between humans and robots. P7 felt that the robot would not have a choice but to accompany humans, which indicates an interaction that is less affective and more authoritative, "*So in case there's nobody to come with me, then there is the robot. It doesn't matter for a robot if they are willing or not*". Also, reservations about the robot because it is a machine seen as P2 referred to the robot as a machine and thought it was unhealthy to get attached to it, "*It would be unhealthy for me to get attached to a machine in the way that I would with a pet*". The robot's expression of being alive, either through bodily movements or showing autonomy and independence, was found to be a quality of being alive which then led to more affective responses from the users. So, robots' behavior that would demonstrate that they are more than obedient tools might be an important feature for walking companionship. On the other hand, this anyway might require active suspension of disbelief by participants since deep down they might know that it is a tool they own as can be seen in the words of P6, P8, and P9. In the long term, it might break the spell of being a "real" walking companion. This poses an important question, would users want robots with the agency in a way that would deliberately go against their will? and, would this be a way to develop affective robotic companions?

Participants felt like they were responsible for taking care of the robot and ensuring that it was protected. They treated the robot like a sophisticated entity that needs to be taken care of. For P4, a major part of the interaction felt like taking care of and doing things for the robot, "*I think I had to take care of it all the time, I have to wait, I have to open the door, I have to wait for it to get the environment and also when I wanted to cross the road*". P5 was being protective of the robot and looking out for it when they went on to walk on the roads, "*I have to be careful about the robot, so if a car will come then I'm more careful or I didn't know how to react at the crossroads so I had to always look at the robot and see what it's doing?*". P2 said, "*We even had the chance to cross the road and that's a scenario where again having a robot with you means you need to take care not only of yourself but of someone else as well*". Similar to taking care of the robot, participants were concerned about the robot's safety, especially where the surroundings were challenging and with a lot of unpredictability. P2 felt attached to the robot and felt guilty for possibly putting the robot in danger, "*And I think in the crossway, I wasn't too sure whether a pedestrian was allowed to actually cross there. So, I don't know too much about the roads and I didn't know if I was supposed to cross there.… So, I felt a bit bad for having it crossed there as well*". Participants, either because of agency towards the robot or because of considering the robot as a sophisticated tool, felt protective of the robot and did not want to do anything that might endanger it. In this case, P2 felt empathy towards the robot, but on the other hand, P4 and P5 felt that they needed to take care of the robot because it was with them, and it was their responsibility. These two things can be characterized as caring towards the robot and being careful about the robot. However, in both cases, participants expressed concerns over the robot's safety, which can be considered as a mediator of affective relationality.

B. Theme 2 - Embodied Social Interaction and HR Proxemics

Participants were aware of their own bodies as well as the robot's embodiment during the walking activity as they recognized the role of being co-situated with the robot. The social embodiment helped them be aware of their surroundings and be mindful of the whole walking space. P1 felt more aware because of the presence of the robot, "*When I'm with the robot, it's as though I'm more present and more aware of the fact that I am here with my body and I'm, you know, someone else is here*" while P2 was more mindful compared to when they walk alone, "*I was mindful of it, kind of being aware of something with me, whereas when I walk on my own I would, you know, I would be busy thinking about, you know, my day*". P2 also felt the presence of the robot made them aware of their own body as well as the presence of other embodied agents like the robot, "*So I was mindful of the robot, Not taking care of but being aware of it*". For many, walking is an escape into an imaginary world. However, a companion robot pulls them back to reality, increasing their awareness of surroundings, which is beneficial for safety and mindfulness. It helps them notice things they usually wouldn't. Conversely, a robot that requires attention disrupts this sense of escapism, making it a less ideal choice for those seeking solitude.

The robot provided the participants with a sense of belonging and companionship, even though it did not fully satisfy their walking needs. P4 said, "*So if I want to compare it with walking alone, I would say it was more interesting, although it slows me down, I think that it was nice to have something or someone with you*". P8 noticed that the robot took some time to become a companion, "*One thing I noticed that when we were walking towards the exit at first. It was a bit lagging behind and I had to keep checking back, but then when we were after some time of walking, we started actually being a companion like it was right next to me all the time*". Walking with a robot is not necessarily a beneficial thing that somehow improves how we walk. It's rather an experience that takes walking to a different dimension by introducing companionship, care, social relationality, and purpose. Participants reported that walking with the robot required them to reduce their walking speed and sometimes they had to move out of their natural walking habit to be with the robot. However, the fact that participants modified their walking behavior for the robot is a testament to their connection with the robot.

Being in close proximity to the robot helped participants understand how close they could get to the robot and how close the robot could get to them. P2 needed some time to understand the robot's movement and once they were familiar, it was not a problem for them, "*And I think after a couple of minutes, you realize how close it can get and then you kind of get just get used to that thing and it's not really a problem*". P8 was also concerned about the proxemics as they mentioned that it might be subjective and may vary from person to person, "*And of course, there are people who don't like when they are accompanied too closely, and that the robot would kind of roam in the in a certain radius of the of the person*". There were instances where the robot almost or actually bumped into the participants. P2 said, "*I could see that it was following me and here and there It kind of felt like, almost like it bumped into me, but it didn't bump into me, but it was about to*". P8 could not really predict the robot's direction and felt like they might walk into the robot, "*There were some times that I was afraid I'd bump into the like, walk into the robot, or that they would walk into me because I couldn't fully predict its next move because it was going not fast, but it changed direction quite quickly, so it was hard to predict and that worries me in a way, like, you can't expect if you can't expect it, you know, how do you maneuver around that?*". P9 was also afraid of walking over the robot, "*Yeah, I would say like, especially when it kind of suddenly took a turn, where it's like turn right in front of me, I kind of watch out so that I don't accidentally walk over it*". The robot did bump into P7 which made them think that it does not really see all around, "*And it probably does not see everything all around, because it hit me*". While in close proximity with the robot, participants became concerned about personal space and wondered if they were moving too close. Being too close might seem uncomfortable while it is also not very safe to be too close to a robot that might act unusually due to the presence of many sensors. Understanding the comfort levels and practices of proxemics can be different based on cultures, social norms, and familiarity with the interactive counterpart [23]. This is also true for human-robot interaction and needs to be taken into account to ensure comfortable yet effective communication.

C. Theme 3 - Robot's influence on self-expression and social values

Similar to a study that found pets being perceived as extensions of their owner's self [24], our participants felt the robot was an extension of their expression and some of them were embarrassed by the attention from people around them. P1 said, "*I was a little bit confused and embarrassed because people were looking at us all the time*". P1 said that they are not embarrassed by themselves or the robot, but the attention from other people brings the embarrassment which sheds light on how people's self-expressions are affected, "*Other people, they have their opinions and everything and it is too much attention… And the embarrassed feeling comes exactly from other people*". P2 also sensed the attention on them, "*Well, it attracts attention, so if you're an introvert and you were just walking on your own with the robot, you can expect some attention*". The co-existence of robots and humans in the same physical activity includes the active agency of all actors. In this regard, the activities and behaviors of the companion robot have a great impact on human self-expression and are subject to judgments based on social norms, because they feel that this robot also represents them and what they stand for [25]. So, when people pay special attention to them, it usually feels like people are questioning their self-expression or deeming it abnormal.

There were questions about social norms and values while trying to make sense of the attention of people. P3 tried to explain why it is not the same type of attention compared to walking with dogs, and how having dogs is a normal thing in the societal context whereas having a robot is unusual. P3 also expects that there is going to be a transition period where these social conflicts will occur, "*I can imagine that if these kinds of robots would be robot companions would become a thing. There would be a transition period where people who get one of those would be looked down on or looked strangely at, let's say for a while because they are. Odd, right?… It stands out. Whereas if you walk around with a dog. It's fine, right? No one. Would look strange to at you for that, yeah*". P9 had a slightly different outlook on how people were reacting and completely ignored them to focus on the robot itself, "*Yeah, I guess, maybe at the beginning, I was more aware of the people, like around me and people reacting to the robots and yeah, but especially towards the end, I'd say I was more just kind of focused on the robot, just look at what it's doing, and just trying to keep up with it*". Despite increased adaptation of robots, their use in daily activities like walking is not yet normalized, creating an unfamiliar experience for both participants and spectators. For example, walking with a companion robot is new for humans and unusual for onlookers. Initial reactions are often influenced by social values and self-expression. P9, during later walks, ignored others' attention, highlighting how people care about others' opinions of their actions. While this varies among individuals, it will take time for society to get used to such scenarios.

D. Theme 4 - Ambiguity and Trust in HR Engagement

Unsurprisingly, participants thought there was not enough communication with the robot and it lacked feedback, based on the relatively short time that was spent with the robot. There was a lack of transparency in the robot's behavior as well, which made the participants confused about what to expect from it. P2 felt that they did not know how the robot follows them and how it recognizes them, "*Because I don't know how it works. Like. Yeah. Does it latch on to me? or not? Will it then be able to follow me? Will it recognize me? How does it even recognize me?… I didn't know those things, so I was concerned about losing it in the crowds*". P3 also felt similarly and did not know if the robot was actually

following them, "*Even though sometimes, for example, when we were about to enter the building, it takes a turn and starts heading towards someone who's clearly not me. Then it feels difficult because I have no control over it*". P7 wondered why this type of thing happened and wanted to know how they could prevent this ambiguity, "*Yeah, it made me think like, what, what is it thinking? What is making it act this way basically and what can I do to prevent it from happening again?*" These things made the participants doubt the robot's credibility as a companion. The biggest concern about ambiguity in the engagement was the fear of losing the robot to someone else. Participants were worried if the robot actually recognized and followed them because there was no clear indication from the robot that they were the ones the robot was following. This happened because the participants did not know exactly how the robot tagged them to be the companion. At the same time, participants were not controlling the robot which increased the fear that the robot might leave them, and they would have nothing to do. Possible solutions to this would be to have some high level of control over the robot such as a robot leash [26] or a feedback mechanism that clarifies who the robot is following.

The movements of the robot were also a black box to participants, and they did not really understand why the robot changed its movement suddenly at times. P2 felt that these movement changes were not intuitive although not always unpleasant, "*I wouldn't say that its stops were intuitive like I wouldn't have stopped when it stopped… That was strange to me, except for the bit at the tree. I think that was a nice place to stop*". P2 also wondered if the robot was trying to communicate something to them, "*Well, I couldn't put together like it was happening. Why would it have done that.… I would probably think, OK, maybe it was suggesting to me where to go, or maybe trying to get my attention*". P7 also complained that the communication is not clear, "*The interaction is limited and the communication is not there*". P5 experienced both the problems of random stops and unknown following behavior, "*It was sometimes weird when it changed the type of walking in the middle of nothing, all of a sudden.… And I didn't know if it's still following me, or sometimes switch to following something else*". P3 went further ahead and said that they want some kind of interface to communicate with the robot, "*I want an interface you have to tell the robot, now we're going to cross the road, now you stop, now we wait for the green light, whatever it might be*". Participants felt a lack of communication with the robot, particularly when it changed its movement patterns. This was due to the robot's absence of a feedback mechanism to explain its actions, and the dynamically generated movements that did not follow a strict pattern. While one participant (P6) could follow the robot's gaze, most found the movements random and meaningless. This contradicts the positive view some had of the robot's autonomy. Although autonomy and agency are preferable, how they are expressed impacts the companion experience. Ambiguity in communication was undesirable, and the lack of cues about walking direction or actions disrupted the experience. Further studies are needed to design communication cues that maintain the robot's agency and independence while reassuring users about its actions.

To diminish the ambiguity and build familiarity with the robot, some participants took an active stance to explore the robot's capabilities by pushing its limits. P1 tried to play a "going-around game" to see if the robot would follow them, "*I was able to communicate, and we even had a small game*". P4 felt that they could do something crazy with the robot to see its reactions, "*Actually I was curious to do something really weird, for example, just jump into the road to see what does it do but then I thought OK why should I put myself in danger and also it in danger to do something*". P8 tried to see if the robot would respond to changes in speed, "*So I did a bit of an experiment like I ran forward a bit and looked at how it would react to sudden change, in distance and speed*". This would be a very intriguing way to understand the capabilities of a robot companion and at the same time invoke contextual feedback from it. Fostering curiosity, creativity, and playful engagements [27], can create an interesting dynamic between humans and robots which then might be able to aid the ambiguity in communication [28]. Yet, diminishing the ambiguity and building trust, rather than solely being features of robot design, may depend on the lived experiences of robots and humans together. As with anything new, familiarization and synergy take time to develop through practice.

IV. Implications and Lessons Learned

In this section, we discuss how the lessons learned from those themes contribute to the understanding of robots' influence on the walking experience as well as implications for further investigation.

A. Empathy and Intimacy Towards the Robot Through Sentimentality

Robots, especially those that resemble something cherished by humans (e.g., pets, babies), hold a sentimental value for humans, fostering the creation of intimacy and empathy. Previous research also confirms that the familiar and pleasant appearance and behavior of robots help create the initial connection [21], [22]. In our study, this initial connection led to the feeling of "being responsible" as well as feeling the need to "care for" the robot as in theme 1.

B. Is It a Tool or Is It a Companion?

While a robot's appearance might portray it as anthropomorphic or functional [29], it is the usage scenario that decides what it really is. A robot's movements and behavior can contribute to its expression of being alive,

however, if it is deployed mostly in scenarios where it simply follows commands, then it is just another tool with a different appearance. Especially, when it comes to robots being treated as machines or command-following entities, it is more likely to be treated as a tool rather than a companion. This also reflects on what is expected of such robots and how they are treated in an interaction as in theme 1.

C. Social and Spatial Awareness Through Embodied HRI

Being in a social and embodied interaction with a robot helps humans be aware of their surroundings both socially and spatially, as discussed in theme 2. Additionally, walking with a robot can attract the attention of passersby, or might lead to conversations between them, as in theme 3. This may not always be comfortable for humans accompanied by robots and might take from the experience of walking with a companion. While this might cease to be a problem in the future, when robotic companions are a common daily occurrence, in the current state, early adopters might need to face up to unwanted social attention.

D. Conservation of Personal Space and Spatial Dynamics

Personal space and spatial dynamics have a great influence on the comfort levels in any interaction and it is the same with embodied HRI. While understanding the comfort levels and practices of proxemics can be different based on cultures, social norms, and familiarity with the interactive counterpart [23], ensuring proxemic and spatial awareness is necessary to make communication comfortable and effective. Theme 3 discusses this with examples such as the anxiety caused by the robot coming too close or being in a crowd with the robot. This will help ensure safety considering robots are after all programmed agents that are prone to failure.

E. Changes in Self-expression Through Robot's Co-existence

The behaviors of and interactions with companion robots might influence human self-expression and are often judged according to societal norms, as discussed in theme 3. Individuals perceive these robots as extensions of themselves and their personal values, for example, the human feels watched or ashamed of the attention the robot gets. Consequently, when attention is directed toward these robots, it can feel as though one's self-expression is being scrutinized or deemed unconventional, as discussed in theme 3.

F. Trust Issues and Uncertainty due to Lack of Feedback and Communication Ambiguity

Feedback is of great importance in daily-life HRI scenarios because these are embodied and social in nature [30]. Lack of feedback can create uncertainty in the interaction and might result in unwanted or accidental circumstances. As discussed in theme 4, participants were confused about the robot's state, its movements, and the next actions as there was no communication or feedback from the robot. A walking companion robot needs to convey clear directions of its movements and status so that its human counterpart can sort themselves out in close proximity, which can result in improved trust.

G. Curious Exploration to Diminish Ambiguity

Curious exploration and playing with the robot's capabilities were found helpful in tackling communication ambiguity. As discussed in theme 4, participants tried to explore how the robot behaves by varying their own walking speed, pattern, and path, which led to them having a better connection with the robot, reducing ambiguity to some extent. However, clear ideas about the robot's capabilities and the environment are needed for such exploration to avoid unwanted situations.

V. Limitations and Future Work

Although we managed to gather a very diverse group with different cultures, all participants were of young age and were either university students or staff. They are usually more inclined towards liking technology in general while people from other age groups and occupations might have a different view on the walking experience. More detailed studies with a larger participant pool might be able to address the gap in data diversity by introducing a more diverse group in terms of age, gender identity, ability, walking habits, pet ownership, and occupation.

In addition to that, more insights on different relationalities such as collaborative, authoritative, or mixed could be uncovered with further analysis. Finally, it would be interesting and very important at the same time to investigate the long-term effects of walking with robots after multiple interactions by eradicating the novelty effect.

VI. Conclusion

This qualitative study was designed in an attempt to answer the broad questions of how co-performance and companionship work between humans and robots in a walking scenario and how it affects humans' overall walking experience. The findings of the study, although not conclusive because of the limitations in participant selection and specific surroundings, shed light on four very important aspects of walking companionship between humans and robots. Aspects like affective relationality, human-robot proxemics, reflection on social values, and trust building through reducing ambiguity appear to influence human-robot walking companionship and need to be considered carefully when designing similar interactions.

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