"I Never Imagined a Robot Speaking Urdu:" Exploring the Influence of Language on Robots' Acceptance

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***Abstract*—As robots are increasingly becoming part of daily life worldwide, it is important to ensure that they are inclusive and culturally sensitive to accommodate users from different backgrounds. In particular, many countries in the Global South (GS) have yet to explore the integration and benefits of robots, especially for underrepresented language groups such as Urdu. We present an exploratory mixed-methods study that investigates how robots' language affects the social interaction, acceptability and overall perception of robots within Pakistani Urdu-speaking individuals. The findings highlight the importance of language and cultural adaptation, and how these factors influence the acceptance of robots, emphasising the need for more inclusive and religion sensitive technologies designed for the GS users.**

***Keywords*—Urdu-speaking robot, Human-Robot Interaction, Social interaction, Culture, Language, Pakistan, Global South.**

CCS CONCEPTS
Human-centered computing → Human computer interaction (HCI); User studies; **Computer systems organization** → Robotics.

I. Introduction

Urdu, a language spoken by over 100 million people across Pakistan, India, and diaspora communities [20], carries rich cultural and linguistic traditions. However, there are not many technologies developed to help or verbally interact in Urdu [5], [6]. As a result, Urdu-speaking individuals, particularly older adults who may have specific needs for assistance, cannot benefit from recent technological developments that are predominantly designed for English-speaking users [7] and other major languages, such as Mandarin [29], Spanish [30] or Japanese [28].

With rapid advancements in technologies, robots are becoming more popular in modern societies worldwide. However, in many areas of the Global South (GS) where language diversity is immense, the integration of robots faces additional challenges such as cost, accessibility, and cultural adaptation [1], which influence robots' acceptability [2], [31]. Another important factor influencing acceptability is verbal language [3], [34], which is crucial in robot design [33]. This is especially relevant for older adults in Urdu-speaking populations, who could rely on robots for assistance in daily tasks and require communication in their native language. Thus, using a robot speaking in Urdu through pre-recorded audio snippets, this study explored 1) the acceptability of robots among Urdu-speaking individuals, focusing on the impact of language on their perception of robots and how robot's language proficiency influence social interactions with the robots, and 2) participants' level of acceptance and understanding of robot's responses. Through mixed methods, we focused on individuals' preferences and attitudes towards the robot's language and explored if it could be useful in their home settings. This preliminary study contributes to understanding of how language influences the communication between the Urdu-speaking users and robots, and how this can affect their interaction with robots.

II. Background

Several studies have investigated the potential of robots in assisting older adults with their daily lives [21]–[23]. Some research has also described the potential of robots supporting older adults at home [14], [18], [24]. However, in the GS region, particularly in South Asian countries like Pakistan, there are very few technologies implemented to support older adults in their home settings, and even fewer are available in their local language, Urdu [19]. One such study conducted in Pakistan involved the development of a Urdu-speaking virtual assistant platform called SAATHI [6]. It aimed to assist older adults with essential tasks such as reminding them to take their medications, organizing their schedules, providing daily news, and facilitating connections with their loved ones. The results indicated that participants responded positively to the platform, demonstrating its potential among Pakistani older adults [6].

Research in the Global North (GN) shows that robots have significant potential to support older adults at home [24], [25], but older adults in Pakistan have not yet benefited from this. The current population of people aged 60+ in Pakistan is estimated to be 7.3 million [17] and this number is expected to rise. However, with the increasing normalisation of nuclear family structures in Pakistani society [16] and the busy

lifestyles of modern individuals, there is often a lack of support for older family members. Consequently, the older adults may end up feeling isolated and confined to their homes, which can have a negative impact on their emotional and physical well-being [19]. As a result, there is a growing demand for technology that can assist older adults in their daily tasks and help them stay connected with their loved ones [18], [19]. Therefore, this study is the first step in exploring whether a robot that speaks Urdu has the potential to serve as a companion for Urdu-speaking older adults in Pakistan.

III. Methods

A. Research Context

Our research aims to investigate the use of robots in Pakistan with older adults in their home. To do so, we first collected design requirements for deploying the robots in the home to assist older adults with their medication management [14]. We then conducted a lab study in Pakistan where 14 older adults interacted with 3 differently embodied English-speaking social robots [4]. The goal was to identify the robot embodiment that is more acceptable for older adults in Pakistan and any potential challenges older participants may encounter if one of these robots was placed in their homes. We found that participants preferred a humanoid robot compared to an animal-like or a toy-like robot. We also identified a significant language barrier as a primary challenge, even though participants were proficient in English. This led us to prepare a robot that uses Urdu speech recordings and to investigate its acceptance among Urdu-speaking individuals from Pakistan living in the United Kingdom, where all authors reside.

B. Participant Recruitment

We recruited 8 Pakistani immigrants (5 women and 3 men) residing in the UK, fluent in Urdu and proficient in English. They were aged 40+ years old to cover both older adults and adult children whose parents could benefit from robotic assistance. Participants were recruited through convenience sampling [8] by advertising the study on authors' social media platforms and within the university premises. The inclusion criteria required the participants to speak and understand Urdu language at least A1 beginner level. We used a Likert scale to evaluate participant's Urdu proficiency, where 0 represents beginner and 5 indicates native. On average, our participants had Urdu proficiency score 3.63 out of 5 (see Table I). All participants were 1st generation migrants from Pakistan residing in the UK. As a token of appreciation, participants received £20 shopping vouchers. The study received a favourable ethical opinion from the author's institutional review board.

C. Robotic platform and Speech control

We used Nao [40], a medium-sized humanoid robot (57.4 x 27.4 x 30.9 cm) from Softbank Robotics. For the study purposes, we introduced the robot to participants as "Dost-Bot". Dost, meaning "friend" in Urdu, reflects the intention to create a supportive, interactive and friendly relationship between an Urdu-speaking individual and the robot, to provide companionship. We employed a Wizard of Oz (WoZ) [12] setup for controlling Nao's speech. We used 148 pre-recorded Urdu phrases using a female voice, generated by the text-to-speech platform from the Center for Language Engineering in Lahore, Pakistan [41].

D. Study Setup, Procedures and Materials

The study was conducted in March 2024, in a lab setting. First, participants were asked to fill out a demographics questionnaire that was also used to confirm participants' eligibility for the study and their Urdu language proficiency. Next, they completed the sociability assessment questionnaire that was used to understand participants' personalities [27]; if the participants perceived themselves as introverts and shy, the robot would give more prompts to initiate the conversation.

The robot was placed on a table in a sitting position. After the questionnaires, participants were given an activity sheet that included different conversation scenarios: informational scenarios (e.g., weather updates and interesting facts), operational scenarios (e.g., involving controlling the movements of robots – head, hand, and standing position), learning scenarios (e.g., teaching the robot a word in Urdu and sharing fun facts of the month), relational scenarios (e.g., involving the robot telling a story and taking pictures with the robot), and leisure scenarios (e.g. playing a "guess the age" game and a "circuit saver" game). Then the robot started the session by greeting and welcoming the participants. Participants chose the activity from the activity sheet, and started talking to the robot. The interactions took approx. 25 min. and were video recorded.

After completing the interactions, participants were asked to fill out the TAM2 questionnaire [9], [10] and a language understanding questionnaire. TAM2 is commonly used to assess acceptance of technology. Based on previous literature [10], we were primarily interested in two parameters to measure acceptance: perceived ease of use (PEOU) and perceived usefulness (PU). These two parameters are further sub categorised [9] into perceived enjoyment (PE), perceived adaptability (PA), and anxiety (ANX). The language understanding questionnaire was inspired by [11] and aimed to evaluate the clarity of robot's speech and the comprehensibility of the Urdu language. At the end, we conducted semi-structured interviews to understand any additional language problems and the potential of using the robot in a home setting, either by participants themselves or by their older family members. The interviews were conducted in a combination of English and Urdu according to participants' convenience, but were later transcribed in English by the first author for analysis.

E. Analysis

To maintain anonymity, participants were assigned IDs from A1 to A8. The sociability assessment questionnaire contained a variety of questions that allowed us to evaluate the participants' social nature [27]; higher scores indicated higher sociability. For the TAM2 questionnaire, we initially computed Cronbach's Alpha (α) for each acceptability parameter (PEOU, PU, PE, PA, ANX); all exhibited α-values

IDs	Gender	Urdu proficiency	Sociability Score	Robot understanding Human	Score	Human understanding Robot	Score
A1	Female	3 (upper intermediate)	3.63	Mostly Understanding	4	Mostly Understanding	4
A2	Male	0 (beginner)	3.37	Mostly Understanding	4	Marginal Understanding	2
A3	Female	4 (advanced)	2.75	Mostly Understanding	4	Mostly Understanding	4
A4	Female	5 (native)	3.00	Mostly Understanding	4	Mostly Understanding	4
A5	Female	2 (intermediate)	3.50	Mostly Understanding	4	Partial Understanding	3
A6	Male	5 (native)	4.25	Mostly Understanding	4	Mostly Understanding	4
A7	Male	5 (native)	3.50	Complete Understanding	5	Mostly Understanding	4
A8	Female	5 (native)	3.12	Complete Understanding	5	Complete Understanding	5

TABLE I: Participants' details, including Urdu language proficiency and Human-Robot language understanding.

greater than 0.7, demonstrating the reliability of the data [26]. Then, basic descriptive statistics was performed on each parameter, including minimum, maximum, mean scores, and the standard deviation. They provided an initial understanding of our data based on score distributions [13]. For the language understanding questionnaire, we used a Likert scale to measure the perception of robot understanding the participants and vise versa (from "1" representing no understanding and "5" full understanding) [11]. Lastly, we closely observed the interactions in the recorded videos to evaluate participants' engagement with the robot during the activities. We mainly focused on observing participants' facial expressions, verbal responses duration and gaze [32]. For interviews, we adopted the framework analysis [15] approach because we were interested in specific questions.

IV. Findings

This section discusses the combined preliminary results from the questionnaires, video observations and framework analysis. The overall data revealed three main themes:

A. Robots' language proficiency is key for acceptability

Participants consistently highlighted the importance of robots being able to speak Urdu and how this improved communication and comfort with the robot. All participants found it convenient to talk to the robot in their native language. Observations from the interactions revealed that the participants responded better verbally to the robot and displayed more smiles compared to our previous study where participants had to speak English with the robots [4]. One participant said:

> "It was a huge advantage for me that the robot could speak and understand Urdu. I never imagined a robot speaking in Urdu language. I felt like talking more and more to this robot because I didn't have to think of the right vocabulary in English." (A3)

As some participants were not native English speakers, they worried that not being able to pronounce English words properly could lead to possible misunderstanding by the robot. However, when speaking in Urdu, there were fewer chances of making mistakes. Moreover, participants also believed that the robot speaking Urdu could foster a sense of familiarity and belonging. One participant commented:

> "When the robot speaks Urdu, it feels like it is a part of us. It can understand me without any problems and miscommunications." (A4)

Parameter	min	max	mean	std. dev	mode
Anxiety	1	3	1.56	0.46	1.25
Perceived Enjoyment	3	5	3.7	0.6	3.8
Perceived Adaptability	3	4	3.88	0.35	4
Perceived Ease of use	2	5	3.97	0.74	4
Perceived Usefulness	3	4	3.80	0.42	4

TABLE II: Descriptive statistics on user acceptance parameters

During the interactions, participants with higher proficiency in Urdu had a better understanding of the robot's language, while those with lower proficiency reported less understanding (see TABLE I). Moreover, the results of the descriptive statistical analysis for each acceptability parameter revealed patterns related to users' perceptions of the robot (see TABLE II). Participants generally reported lower levels of anxiety while interacting with the robot and found the robot enjoyable, adaptable, easy to use, and useful.

The observations revealed that participants who were not native Urdu speakers preferred to use a combination of Urdu and English while the robot communicated exclusively in Urdu. They also expressed a desire for the robot to use a similar mix of languages and perhaps even incorporate slang to sound more casual and less formal. However, it remains an open research question whether the robot speaking solely in Urdu would encourage or hinder bilingualism among users.

B. Cultural and religious compatibility

Participants emphasised that the robot's design should align with the cultural norms and values of Urdu-speaking communities. Since all the participants were living in the UK and were aware of the technologies available in Pakistan, they discussed and compared the two regions. They expressed concerns that most technology has been designed for the GN and lacks sensitivity to other cultures. One participant stated:

> "The robot speaking my language shows respect for my culture. It feels great that there is finally something people from my culture can relate to."(A7)

Participants mentioned that the robot should not only speak Urdu, but also exhibit behavior and responses based on Pakistani culture and religion. Since Pakistan is an Islamic state, religion is of great importance. Participants wanted the robot to talk more about religious aspects, such as reminding them to pray, recite prayers before and after eating, help them learn and read the Quran, and understand its history. A participant said:

> "Robot should use common Islamic phrases like *InshaAllah* [God Willing] and *Alhamdulillah* [Thanks to Allah (Muslim God)] during conversations. It should also provide reminders to read Surahs, along with their benefits and history." (A5)

C. Design consideration and possible use cases

While participants generally expressed openness to the idea of robots, they raised concerns about the appropriate level of formality in the robot's speech. Urdu has several variations that convey different levels of formality. In everyday interactions, people tend to be less formal, and participants felt that the speech developed for the robot was too formal for casual conversation and could be improved; e.g. one participant said:

> "The robot speaks Urdu as if it's reading news on an Urdu news channel. I may not understand it all, but the good thing is that it understands me very well." (A2)

Two participants even mentioned that they could think of the robot as their confidant, someone they could trust and with whom they could share everything:

> "It's like having a loyal friend who listens to everything but never judges or shares your secrets." (A7)

V. Discussion

Our work has implications that should be considered when designing Urdu-speaking robots, which may also apply to other underrepresented languages. We discuss them below.

A. Linguistic sensitivity enhances acceptance

Our study established that the robot speaking Urdu was helpful for the Urdu-speaking individuals, highlighting the emotional and cultural significance attached to language. As illustrated by participants' comments, language is not merely a functional tool for communication but also a medium for cultural identification. Our work supports previous research showing that users get along well with the robots when they speak their own language [33], [34]. Similar to prior work (e.g. [3], [28], [33]), when the robot spoke Urdu, participants felt a sense of familiarity, respect and comfort, which positively influenced their perception of the robot. This sense of familiarity could potentially enhance the acceptability of robots, making them more user-friendly in diverse cultural contexts [9].

Participants mentioned the possibility of using a mix of languages, which Choi et al. suggested as a way to facilitate good communication for some people [39]. However, during the discussions, they mentioned that this approach might not be comfortable for everyone. In Pakistan, where Urdu serves as the national language, individuals with lower levels of literacy may face challenges with multilingual communication. A robot speaking solely in Urdu would be more natural and less intimidating to the people, capturing a wider audience. If designing a robot that uses underrepresented language, designers have to think through the consequences in general; and particularly how the choice of language can impact user comfort and inclusiveness in diverse communities.

B. Importance of religious sensitivity

Our study highlighted the need for the robot to be sensitive to religious practices. This cultural competency is important for the robot to be fully integrated into users' lives, particularly in regions where religion plays a central role in daily routines [35], [36]. Even though our participants were keen to have a robot incorporating religious and cultural elements, this could also be problematic and should be addressed with care. Dahlan et al. suggests that the world is going towards creating robots that closely resemble humans; however, Muslims may accept the robot as *human-like* but not as a *human* [37]. For this reason, when designing robots for GS communities, we need to consider the following points that warrant future research:

1) How can robots be designed to respect religious practices without conflicting with religious beliefs?
2) What ethical considerations arise when designing robots to engage with deeply personal aspects of users' lives, such as religion and spirituality?
3) Could the integration of religious sensitivity in robots lead to unintended consequences? What would they be?

C. Thinking design before functionality

Beyond task management and reminders, robots can potentially play a broader, more holistic role in supporting well-being. Robots could serve as a *confidant* for older adults experiencing different emotions, as highlighted by Tang et al [42]. However, to fulfill this role effectively, researchers must develop robots that are capable of providing empathetic interactions for individuals who need to share their feelings in order to feel better. It's also important for these robots to be sensitive to the communities where religion plays a central role in people's lives. By tailoring the robots to meet users' specific requirements, robots' functionalities could be expanded accordingly, potentially leading to improved acceptance.

VI. Future work

It is important to acknowledge that the perspectives of our recruited participants may differ in how they perceive and engage with technology that incorporates culturally familiar elements, compared to those currently living in the Global South. Keeping this in mind, as a next step, we plan to deploy the Urdu-speaking robot in Pakistan home settings with the older adults living alone. The primary purpose will be to explore its potential to provide companionship by engaging in conversations about hobbies and playing games. Additionally, we will explore the opportunities to support daily routine tasks while taking into account users' emotional and religious needs.

VII. Conclusions

This study used a mixed-method approach to investigate the use of an Urdu-speaking robot. The results found that for a robot to be accepted by Pakistani Urdu-speaking individuals, it must have more cultural and religious knowledge to establish a stronger connection with users, ultimately improving their overall experience and acceptability of the robot.

REFERENCES

[1] Chi, Oscar Hengxuan, et al. "Customers' acceptance of artificially intelligent service robots: The influence of trust and culture." International Journal of Information Management 70 (2023): 102623.

[2] Takanokura, Masato, et al. "Implementation and user acceptance of social service robot for an elderly care program in a daycare facility." Journal of Ambient Intelligence and Humanized Computing 14.11 (2023): 14423-14432.

[3] Lugrin, Birgit, et al. "What if it speaks like it was from the village? Effects of a robot speaking in regional language variations on users' evaluations." 2020 29th IEEE International Conference on Robot and Human Interactive Communication (RO-MAN). IEEE, 2020.

[4] S. Ahmad, "Understanding the impact of robots' embodiment on user acceptance and engagement: Perspectives of older adults from Pakistan" unpublished.

[5] Rehmani, Talha, et al. "Designing robot receptionist for overcoming poor infrastructure, low literacy and low rate of female interaction." Companion of the 2018 ACM/IEEE International Conference on Human-Robot Interaction. 2018.

[6] Kumar, Anand, et al. "Saathi: An urdu virtual assistant for elderly aging in place." International Conference on Smart Homes and Health Telematics. Cham: Springer International Publishing, 2022.

[7] Cumbal, Ronald, et al. "Stereotypical nationality representations in HRI: perspectives from international young adults." Frontiers in Robotics and AI 10 (2023): 1264614.

[8] Etikan, Ilker, Sulaiman Abubakar Musa, and Rukayya Sunusi Alkassim. "Comparison of convenience sampling and purposive sampling." American journal of theoretical and applied statistics 5.1 (2016): 1-4.

[9] Heerink, Marcel, et al. "Measuring acceptance of an assistive social robot: a suggested toolkit." RO-MAN 2009-The 18th IEEE International Symposium on Robot and Human Interactive Communication. IEEE, 2009.

[10] Abrams, Anna MH, et al. "A theoretical and empirical reflection on technology acceptance models for autonomous delivery robots." Proceedings of the 2021 ACM/IEEE International Conference on Human-Robot Interaction. 2021.

[11] Lopes, José, Olov Engwall, and Gabriel Skantze. "A first visit to the robot language café." ISCA workshop on speech and language technology in education. 2017.

[12] Maulsby, David, Saul Greenberg, and Richard Mander. "Prototyping an intelligent agent through Wizard of Oz." Proceedings of the INTERACT'93 and CHI'93 conference on Human factors in computing systems. 1993.

[13] Heerink, Marcel, et al. "Measuring acceptance of an assistive social robot: a suggested toolkit." RO-MAN 2009-The 18th IEEE International Symposium on Robot and Human Interactive Communication. IEEE, 2009.

[14] Ahmad, Sunbul M., et al. "Exploring the Potential of Social Robots in Supporting Home Medication Management." 36th International BCS Human-Computer Interaction Conference. BCS Learning & Development, 2023.

[15] Furber, Christine. "Framework analysis: a method for analysing qualitative data." African Journal of Midwifery and Women's health 4.2 (2010): 97-100.

[16] Ashiq, Uzma, and Amir Zada Asad. "The rising old age problem in Pakistan." Journal of the Research Society of Pakistan–Vol 54.2 (2017).

[17] Population by 5 year age groups - Pakistan. https://www.pbs.gov.pk/sites/defa ult/files//tables/POPULATION20-

[18] Costa, Angelo, et al. "PHAROS—PHysical assistant RObot system." Sensors 18.8 (2018): 2633.

[19] Kumar, Anand, et al. "Saathi: An urdu virtual assistant for elderly aging in place." International Conference on Smart Homes and Health Telematics. Cham: Springer International Publishing, 2022.

[20] https://tinyurl.com/mrwak4wv

[21] Li, Lei, et al. "Mobile Robotic Balance Assistant (MRBA): a gait assistive and fall intervention robot for daily living." Journal of NeuroEngineering and Rehabilitation 20.1 (2023): 29.

[22] Nasri, Nadia, et al. "Assistive robot with an ai-based application for the reinforcement of activities of daily living: technical validation with users affected by neurodevelopmental disorders." Applied Sciences 12.19 (2022): 9566.

[23] Huang, Tianyang, and Chiwu Huang. "Attitudes of the elderly living independently towards the use of robots to assist with activities of daily living." Work 69.1 (2021): 55-65.

[24] Kim, Jong-Wook, et al. "A care robot with ethical sensing system for older adults at home." Sensors 22.19 (2022): 7515.

[25] Lee, Othelia EunKyoung, et al. "My precious friend: Human-Robot interactions in home care for socially isolated older adults." Clinical Gerontologist 47.1 (2024): 161-170.

[26] Tavakol, Mohsen, and Reg Dennick. "Making sense of Cronbach's alpha." International journal of medical education 2 (2011): 53.

[27] Mustoip, Sofyan, et al. "Influence of Introverted and Extroverted Personalities on English Learning Interaction for Elementary School Students." Elsya: Journal of English Language Studies 6.1 (2024): 33-45.

[28] Manome, Nobuhito, et al. "Machine translation from Japanese to robot language for human-friendly communication." HCI International 2020-Posters: 22nd International Conference, HCII 2020, Copenhagen, Denmark, July 19–24, 2020, Proceedings, Part I 22. Springer International Publishing, 2020.

[29] Nomoto, Momoe, et al. "Qilin, a robot-assisted Chinese language learning bilingual chatbot." Proceedings of the 4th international conference on modern educational technology. 2022.

[30] Morales, Santiago Omar Caballero, Gladys Bonilla Enríquez, and Felipe Trujillo Romero. "Speech-based human and service robot interaction: An application for Mexican dysarthric people." International Journal of Advanced Robotic Systems 10.1 (2013): 11.

[31] Arakpogun, Emmanuel Ogiemwonyi, et al. "Artificial intelligence in Africa: Challenges and opportunities." The fourth industrial revolution: Implementation of artificial intelligence for growing business success (2021): 375-388.

[32] Castellano, Ginevra, et al. "Detecting user engagement with a robot companion using task and social interaction-based features." Proceedings of the 2009 international conference on Multimodal interfaces. 2009.

[33] Kouri, Susanna, et al. "Customized robot-assisted language learning to support immigrants at work: Findings and insights from a qualitative user experience study." Proceedings of the 8th International Conference on Human-Agent Interaction. 2020.

[34] Kim, Yunkyung, Sonya S. Kwak, and Myung-suk Kim. "Am I acceptable to you? Effect of a robot's verbal language forms on people's social distance from robots." Computers in Human Behavior 29.3 (2013): 1091-1101.

[35] Trovato, Gabriele, et al. "Religion and robots: towards the synthesis of two extremes." International Journal of Social Robotics 13 (2021): 539-556.

[36] Rosenfeld, Azriel. "Religion and the Robot." Tradition: A Journal of Orthodox Jewish Thought 8.3 (1966): 15-26.

[37] Dahlan, Hadi Akbar. "Future interaction between man and robots from Islamic perspective." International Journal of Islamic Thought 13 (2018): 44-51.

[38] Gasteiger, Norina, et al. "Robot-delivered cognitive stimulation games for older adults: Usability and acceptability evaluation." ACM Transactions on Human-Robot Interaction (THRI) 10.4 (2021): 1-18.

[39] Choi, Yunjae J., Minha Lee, and Sangsu Lee. "Toward a Multilingual Conversational Agent: Challenges and Expectations of Code-mixing Multilingual Users." Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems. 2023.

[40] https://www.aldebaran.com/en/nao

[41] https://tech.cle.org.pk/utts

[42] Tang, Brian, et al. "Confidant: A privacy controller for social robots." 2022 17th ACM/IEEE International Conference on Human-Robot Interaction (HRI). IEEE, 2022.