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Exploring the affordances of telepresence robots in foreign language learning

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Abstract

The importance of authentic communicative practices in foreign language (FL) learning has long been recognized. However, most FL learners lack adequate access to authentic communicative environments in the target language. In this article, we propose the use of telepresence robots as a potential solution to bridge this gap. Telepresence robots can be controlled by remote language learners online, enabling them to gain virtual access to authentic environments in the target language and to interact with native speakers in those environments in real time. In this exploratory study, three English learners and a native-speaker of American English participated in a campus tour activity using a telepresence robot. We examined the experience of our participants and the conversational features of their telepresence interactions through analyses of the interview data, field notes, and transcripts of conversations captured on video. Our findings show that telepresence robots have substantial potential for promoting FL learning by providing authentic communicative practice for remote language learners. The findings have useful implications for informing future research design.

Keywords: *Computer-Mediated Communication, Language Learning Strategies, Distance and Open Learning and Teaching, Telecollaboration*

Language(s) Learned in This Study: *English*

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Introduction

The importance of authentic communicative practices in foreign language (FL) learning has long been recognized. Authentic communicative practices provide meaningful contexts that motivate learners and assist them in understanding the meaning of knowledge (Edelson & Reiser, 2006). In the absence of such practices, learners demonstrating adequate language skills in standardized testing situations may not be able to successfully apply those skills in authentic communicative situations (Larsen-Freeman, 2013). Unfortunately, most FL learners lack adequate access to authentic communicative environments in the target language. Researchers have used various virtual presence technologies to facilitate interaction between FL learners and speakers in target language communities, such as video conferencing systems (e.g., Yen, Hou, & Chang, 2015) and virtual reality (VR) environments (e.g., Lan, 2015). However, these technologies fall short in enabling learners to feel physically present in and to explore diverse real-world environments of target language use. To bridge this gap, we propose a solution that uses a telepresence robot—a remote-controlled, wheeled device with a display and camera—to enable FL learners to gain virtual access to authentic communicative environments in the target language and engage in real-time interaction with speakers in those environments.

The term telepresence, first coined by Minsky (1980), refers to a set of technologies that give remote participants the feeling of being present at a different location. Compared to other robots, telepresence robots provide opportunities for interpersonal communication with people at different places, rather than interaction between humans and robots with artificial intelligence. Telepresence robots have been used in

various domains, such as providing home care assistance for elderly people (Michaud et al., 2007), changing the dynamics of a blended learning design studio class (Bell, Cain, Peterson, & Cheng, 2016) and facilitating virtual school attendance by students with physical disabilities (Newhart & Olson, 2017). In the field of FL learning, a few studies reported that the application of telepresence robots in classroom settings significantly improved learner interest, confidence, and motivation (e.g., Kwon, Koo, Kim, & Kwon, 2010; Tanaka, Takahashi, Matsuzoe, Tazawa, & Morita, 2014). Research into the application of telepresence robots in FL learning in real-life settings, however, has not yet emerged. As a first step toward understanding the potential of using telepresence robots for providing authentic communicative practices for FL learners, this exploratory study examines the experiences of four participants in a campus tour activity facilitated by a telepresence robot and the features of their telepresence interactions.

Theoretical Background

Communicative Practices

From the dialogic view of language and learning (Bakhtin, 1981), language is organized dialogically at the level of utterance, which is both context shaped and context renewing (Goodwin & Heritage, 1990). As Volosinov (1973) put it, "the real unit in language that is implemented in speech … is not the individual, isolated monologic utterance, but the interaction of at least two utterances—in a word, dialogue" (p. 117). He further argued that "language acquires life and historically evolves precisely here, in concrete verbal communication, and not in the abstract linguistic system of language forms, nor in the individual psyche of speakers" (p. 95). Based on this view, communicative practices play a critical role in language learning, as it is through engagement in such practices that learners acquire the meanings and functions of language forms in context. In reality, however, most FL learners have few opportunities to engage in communicative practices with speakers in the target language community. According to the International Association of Language Centers, only 0.25% of FL learners are able to travel to target-language countries for educational purposes (International Association of Languages Centres, 2016). It is thus important to find alternative ways to provide communicative practices for FL learners.

Authenticity in Language Learning

Authenticity in language learning refers to the resemblance between what learners are exposed to in learning and what their future language use practices will be like (Gilmore, 2007). Taylor (1994) distinguished three facets of authenticity (i.e., authenticity of language, task, and situation), which were subsequently elaborated on by other researchers. In general, authentic language, tasks, and situations refer to language input that serves real-life communicative purposes (Lee, 1995), tasks that bear real-world relevance and reflect professional skills students will need after graduation (Strobel, Wang, Weber, & Dyehouse, 2013), and situations that resemble real situations of social interaction in daily life (Strobel et al., 2013), respectively. These facets should not be viewed in isolation, as authenticity is a function of many factors all at once, including not only the language but also "the participants, the use to which language is put, the setting, the nature of the interaction, and the interpretation the participants bring to both the setting and the activity" (Taylor, 1994, p. 4).

Virtual Presence Technologies and Computer-Assisted Language Learning

Technologies that can create virtual presence or experiences, including video conferencing systems, VR environments, and telepresence robots, have been utilized to support FL learning. For example, Lan (2015) found that the usage of virtually immersive contexts in English as a foreign language (EFL) learning provided ubiquitous learning opportunities and game-like scenarios and led to enhanced learner performances. Jauregi and Bañados (2008) employed Adobe Connect to enable virtual interaction between Spanish as a foreign language learners and native-speaker Spanish teachers and identified positive impacts on learning outcome, learner motivation, and cultural understanding. Yen et al. (2015) reported that using Skype to facilitate the application of role-playing strategy significantly enhanced EFL learners' speaking skills. A few studies applied telepresence robots in FL classrooms and observed significant improvement

in learner interest, confidence, and motivation (Kwon et al., 2010; Tanaka et al., 2014).

Despite the reported benefits, current applications of virtual presence technologies have their drawbacks when it comes to providing learners with authentic communicative practices. Falconer (2013) reported that characters in VR learning environments are typically depicted in an unrealistic cartoonish style, that the physical environments lack details, and that tasks are designed artificially. Research on language learning via video conferencing systems and telepresence robots has to date been restricted to classroom, office, or home settings (e.g., Kwon et al., 2010; Tanaka et al., 2014; Yen et al., 2015). This limits the types of real-world environments learners are exposed to and the conversational topics that could have naturally arisen from more diverse contexts. Collectively, these drawbacks result in the lack of authenticity. In our view, telepresence robots have the potential to bring about a greater degree of authenticity in all three facets discussed above if used to allow leaners to interact with speakers in the target language community in more diverse real-world environments for genuine communicative purposes.

Research Questions

This exploratory study constitutes a first step toward understanding the potential of using telepresence robots to provide authentic communicative practices for remote FL learners. The specific research questions addressed are as follows:

1. What are the perceived benefits of using telepresence robots in FL learning outdoors?
2. What are the perceived challenges of using telepresence robots in FL learning outdoors?
3. How can we refine the design of tasks to address the perceived challenges?

Methodology

Participants

The data in this study were collected over one week in April 2015. The purposeful sampling strategy was adopted to select adult EFL learners with the plan to study overseas and with no prior experience in living abroad, as the campus tour activity (described below) would be directly relevant to them. Three Chinese EFL learners residing in China (Xiu, Xian, and Gou) were recruited as remote participants (see Table 1); Coleman, a male native speaker of American English enrolled in a graduate program at the university chosen as the research site, was recruited as the local participant (all names are pseudonyms).

Table 1. *Demographic Information of Remote Participants*

Pseudonym	Gender	Age	Occupation	English Proficiency	Years Studying English
Gou	Male	24	Graduate student	Intermediate	12
Xian	Female	28	Government employee	Intermediate	9
Xiu	Female	24	Graduate student	Advanced	12

Technical Settings

Romo, a small telepresence robot,[1] was used in this study. Despite its relatively small size, Romo has most functionalities that other telepresence robots have. Romo allows learners to control its movement via a mobile app, to adjust the view angle of its camera by tilting the smartphone, to see what it captures on the screen of the smartphone, and to start a live video chat with the camera. We used the 4G network on an iPhone to connect Romo to the Internet.

Procedure

The research site was the campus of a large public university in the Eastern United States. The general goal

of the activity was to have the native speaker participant introduce the buildings, history, and culture of the campus to the remote EFL learners as a campus tour guide; the EFL learners would then report what they learned at the end of the activity. The actual activity consisted of three phases: pre-task, task, and review. Each learner completed the task with the native speaker one-on-one in approximately two hours. In the pre-task, the native speaker and the learner spent half an hour video-chatting on QQ, a popular chat app, to get familiar with each other; the native speaker also oriented the learner to the whole task. In the task phase, the learner controlled Romo to participate in a 1-hour campus tour guided by the native speaker, who introduced the history and culture of the buildings along the tour route. Figure 1 and Figure 2 demonstrate the robot interface and the mode of communication between the native speaker and the learner. Figure 3 shows the campus tour route. In the last phase, the learners orally reported what they had learned at the end of the tour. They were then interviewed about their experiences with the task. The native speaker participant was interviewed after all three learners had completed the task.

Figure 1. Communication via a telepresence robot.

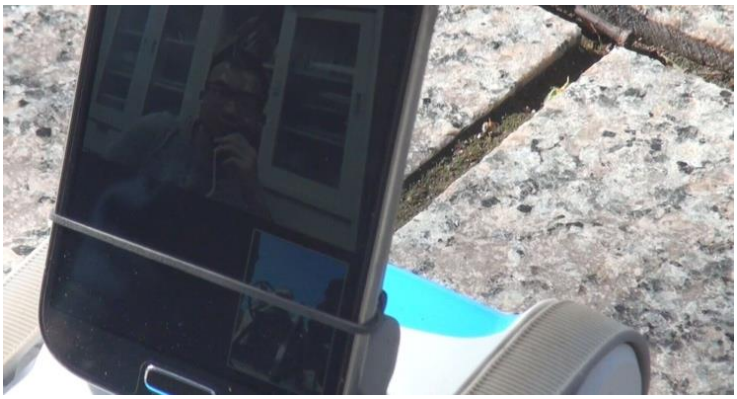

Figure 2. The Interface on the screen of the robot.

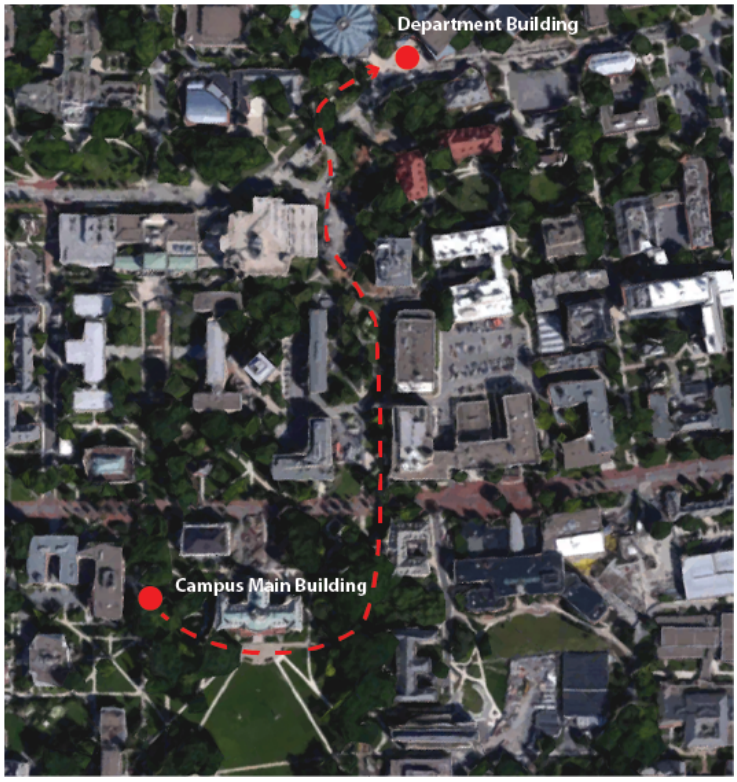

Figure 3. The route of the activity.

Data Collection and Analysis

Throughout the data collection period, four interviews (see Appendix) were conducted, recorded, and transcribed by the first author: three with the EFL learners in Chinese and one with the native speaker in English. The interviews with the learners were translated into English and the translations were crosschecked by the two authors to ensure accuracy. Ten pages of field notes were taken by the first author to document researcher observation of the benefits and challenges manifested in the activity and to triangulate the interview data. The interview transcripts and field notes were analyzed qualitatively by the two authors using Atlas.ti, following the method McMillan (2012) describes. Specifically, the transcripts and notes were read through and words, phrases, or sentences relevant to the research questions were marked up as codes. The coding scheme went through several iterations of merging and splitting, until we were confident that each code could not be further split or merged with other codes. Finally, all codes were categorized into different themes.

In addition, six hours of video interactions were recorded, among which three hours were interactions between the EFL learners and the native speaker via the telepresence robot during the campus tour task. The telepresence conversations were transcribed and analyzed by the first author using the Computerized Language Analysis programs (MacWhinney, 2000). The results of this analysis were used to triangulate those from the coded data.

Findings

Five themes emerged from the 21 codes identified in the field notes and interview transcripts, as shown in Table 2.

Table 2. *Themes and Codes*

Theme	Code	Description	Example
Emotions	Exciting	Participants feeling excited	*The real cool thing is obviously the interaction and the use of technology to actually experience real things.*
	Gaming	Participants feeling game-like experiences	*This robot makes me feel like manipulating a virtual person walking in a virtual world. This is somewhat similar to manipulating a character in a game hanging around in a virtual world.*
	Relaxing	Participants feeling relaxed	*I feel the way we used it today is more relaxing...*
	Challenging	Participants feeling challenged	*I feel it is more challenging considering my English ability.*
Authentic Learning Experience	Real environment	Experiencing another real world via the robot	*Meanwhile, I know the world where the robot is walking is a real world.*
	Social presence	Feeling present in a remote place	*I feel as if I was hiding in a corner watching the foreigners and experiencing many things.*
	Emerging topics	Naturally emerged topics	*I feel that there are more topics to talk about when immersed in the environment.*
	Cultural learning	Learning about another culture	*(Learning in this way) provides an opportunity to learn something about foreign culture.*
Learner-Centered Activities	Learner agency	Learning in an active way	*When watching the introduction videos or photographs of campuses online, I can only receive information passively. With the robot, I can explore the campus actively…*
	Self-impact	The activity is related to students' personal experience	*Especially for college students, it will be very attractive to know something about the lives of students of their age abroad or something related to their majors.*
	Learner difference	Inter-learner differences	*The first student seemed more interested in seeing the campus …, and the other two students seemed really enjoying driving around by themselves.*
	Disorientation	Difficulty in locating position	*When I was operating the robot, it was hard for me to find the destination since I'm not familiar with the campus.*
Technical Issues	Network connection	Issues caused by poor network connection	*Also I mean the lag is there, right? It's a bit of a problem…*
	Robot size	Small size of the robot	*Colman had to crouch down to talk to Xiu.*
	Robot speed	Slow speed of the robot	*As the robot walks slower than human beings, Colman had to hold the robot while we were heading there.*
	Robot sound volume	Low sound volume of the robot	*There were times in the tour when I had to talk pretty loudly to make sure the student can hear me.*

	Reflections on the screen	Display issue caused by strong sunlight	*When the robot is being ridden in strong sunlight, it is a little hard to see Xiu's face on the screen.*
	Body language	Difficulty to convey body language	*I could use gesture and body language when I talk to other foreigners face-to-face. I feel it lacks a way to communicate.*
Practical Concerns	Privacy issues	Concern for privacy issues	*If you don't videotape, you can conduct this study indoors or in a lot of places outdoors.*
	Teacher resource	Concern for the lack of native-speaker teachers	*The first issue is if there are enough native-speaker teachers.*
	Difference from classroom learning	Comparison to learning in the classroom	*When listening to a lesson in the classroom, I focus on something else, like grammar or vocabulary. When using the robot, I need to focus on how to express my ideas more accurately*.

Emotions and Motivation

The EFL learners and the native speaker experienced positive emotions, as expressed using such words as *excited, cool,* and *interesting* during the activities. Coleman noted the following in his interview:

> *It was really cool to see the students' reactions… Students' reactions were really impressive. I think all three of them. There were moments that they just seemed really excited to interact with me or just interact with the environment. And it really shocked me that their interaction with the environment made it really interesting.*

Gou explained the reason he experienced positive emotion from the perspective of gaming in his interview.

> *This robot makes me feel like manipulating a virtual person walking in a virtual world. This is somewhat similar to manipulating a character in a game hanging around in a virtual world. Meanwhile, I know the world where the robot is walking is a real world. It feels like a game experience but what I am experiencing is a real world. This makes me excited.*

Nevertheless, some learners experienced some stress during the activity. For example, Xian mentioned that she felt her English ability was not good enough to communicate with the native speaker fluently. However, both Xian and the native speaker indicated that this challenge could be alleviated by better preparing learners before the activity (e.g., by having them watch some introductory videos about the campus).

Authentic Learning Experience

Authentic learning experiences were created by making learners feel they engaged in the activity as if they were physically on campus. Xian indicated in her interview that she felt as if she were physically present on campus as a student talking to Coleman.

> *When he (Coleman) took me around, it felt like a teacher guiding a student, and I paid attention to everything he said.*

Gou mentioned a similar experience in his interview.

> *As for my other experiences, the most interesting thing is to see the real environment abroad, which is very different from what we have experienced domestically.*

In terms of the benefits of learning in an authentic environment, Xiu's comment in her interview below illustrates how the environment provided a rich and unique language context to facilitate her acquisition of the precise meaning of a culture-related word.

> Xiu: *In our English class at school, we also have a native speaker teacher here, but in China, it's more difficult to come up with examples to illustrate the meaning of something specific to her culture. For*

example, when Coleman told me something about the word quod? I forgot the exact word…

Interviewer: *Quad?*

Xiu: *When he wanted to introduce something like that, he would say, "see it's over there". It was more situated and more precise. Because of the large cultural gap, it's just more difficult to explain things like this in China.*

The following exchange between Xiu and Coleman (transcribed from the video interactions) can triangulate Xiu' points mentioned above (see Figure 4). Jefferson's (2004) transcription system is used here to mark pauses, voice pitch, and non-verbal gestures.

1 COL*: so:,(.){what can you see there = can you see:
2 {((RH points at the quad and then gazes at XIU))
3 XIU*: a v.. a a: (1.1) a plaza ↑ or a square?
4 >plaza ↑ , square?<
5 COL*: yeah, yeah, that's a good way >to describe it<,
6 a pla:za or square like what i said
7 we we usually call this a qua:d right? kweu yew ey dee=
8 XIU*: =oh ↑ , [quad
9 COL*: [yeah, i told you >about this before<
10 so, this is uhm this is really normal for: university
11 campuses right?

Figure 4. Learning the meaning of the word *quad*.

Xiu's example of the word *quad* explicates her view on the usefulness of the physical context for the acquisition of the precise meaning of this word, which could be harder to learn in the traditional classroom setting. Therefore, the physical context around the telepresence robot is not just the background of the conversation, but provides a way to help learners understand the precise meaning of culture-specific idiomatic expressions in the target language.

Another finding is that, along with the learning activities, the authentic environment around the telepresence robot triggered more natural conversational topics and helped the interlocutors organize the topics, as Coleman observed in his interview:

I feel like the tour itself was pretty straightforward. When we were talking about doing this, I was

worried that the students would need like metrics or a worksheet or something to engage them in the tour, but actually it turned out it's not necessary at all. Once we were moving around, it was very easy to have a conversation.

Coleman's comment indicates that the authentic physical environment, including the buildings and other objects encountered on the campus tour, allowed for conversational topics to emerge naturally as they moved along the route, making the activity more natural and closer to real-life communication than conversations in formal learning settings, where the conversational topics are often prescribed.

Learner-Centered Activities

The learning activities were largely learner-centered, as the telepresence robot allowed learners to decide how they wanted the activities to proceed and what they wanted to talk and learn about. Gou's comment in his interview below illustrates how he could actively choose the learning content.

The most impressive part of the experience was that I could control the robot myself. I could find a lot of videos and photos about university campuses online, but this project provides a robot that I can control, which gave me the freedom to see what I wanted to see. It is highly autonomous. When watching the introduction videos or photographs of campuses online, I can only receive information passively. With the robot, I can explore the campus actively, and that's the most fun part of today's activity.

Gou's comment shows that the ability to control the movement and view angle of the robot allowed him to actively explore the environment and choose conversational topics that he was interested in, making the learning process highly engaging. Gou's interview transcript indicates how the match between the learning scenario and his personal interests was a motivating factor for him.

Seeing how foreign college students of our age live, where they live, how they study, and how they eat, I feel as if I was hiding in a corner watching the foreigners and experiencing many things. … Especially for college students, it will be very attractive to know something about the lives of students of their age abroad or something related to their majors.

Coleman also commented on the match between the activity and the learners' interests and the importance of taking learners' background and interests into account in activity design.

It was a really good match between their background and interests and what we showed them today. But I think that would really depend on who you're taking around.

A drawback of the activity was that learners might feel disoriented when exposed to authentic learning environments without adequate guidance, as illustrated by Xiu's comment below.

When I was operating the robot, it was hard for me to find the destination since I'm not familiar with the campus.

Technical Issues

The learning activity generally proceeded smoothly, but there were a few minor issues caused by technical limitations. The most salient one was the occasional lags in streaming video and audio caused by unstable network connection, as observed by Gou in his interview:

As for future improvement, the only thing I can think of is the Internet speed. I don't know if it was because of the Internet connection on my side. The whole activity was well-organized, but due to the lag, I had some problems hearing the teacher, and occasionally the delay was severe. Other than that, the tour was really interesting.

Other issues noted by the participants included the size, speed, sound volume, and the screen of the robot, largely due to Romo's relatively small size. Most participants hoped the robots used for future studies could be taller and faster, with higher volume and a clearer display screen.

A special issue caused by the size of the display screen was about the conveyance of body language. In

particular, the small size of the screen made it difficult to see the gestures and body language of the interlocutor clearly, as illustrated by Xian's comment in his interview below:

> *The communication in our activity lacks one thing. I could use gesture and body language when I talk to other foreigners face-to-face. I feel it lacks a way to communicate [while using the telepresence robot]*.

Practical Concerns

The participants also reported a few practical concerns regarding the use of telepresence robots for FL learning, including the privacy of other people who may be captured by the camera, limited availability of native speaker interlocutors, and the integration of this technology in traditional classroom settings. These concerns are discussed in the next section.

Discussion

The findings from our analyses of the field notes, interview transcripts, and telepresence conversations have well answered our research questions.

Perceived Benefits of Using Telepresence Robots in Foreign Language Learning Outdoors

Our results show that the telepresence robot provided a more authentic and interactive environment for communicative practices than other researched technologies such as VR environments (Falconer, 2013). Such an authentic conversational environment provided multiple benefits to the learners. First, exposing learners to and engaging them in such an authentic conversational environment facilitated their acquisition of the precise meanings of culture-related expressions in the language. Second, this environment allowed for conversational topics to emerge naturally, making the flow of the learning activity easy to organize for the participants. Third, the use of the telepresence robot motivated the learners by providing them with a game-like experience and learner-centered activities. As such, the learners all experienced positive emotions during the activities. Finally, the ability to control the movement of the robot and select learning content based on their own interests and learning needs allowed the learners to align the learning activity with their own zone of proximal development (ZPD; Lantolf & Thorne, 2006; Vygotsky, 1978), that is, the area between what they are able to do with and without expert guidance.

Perceived Challenges of Using Telepresence Robots in Foreign Language Learning Outdoors

The learners reported two major challenges posed by the outdoors activity with the telepresence robot. One challenge was the disorientation experienced by some learners in the new, open environment, and the other was the stress felt by some learners when communicating about certain impromptu topics that they felt they lacked the language skills to handle. On the one hand, these challenges can be seen as useful learning opportunities brought about by the activity. Authentic contexts of language use will necessarily include new environments, in which impromptu conversational topics will naturally emerge. Authentic communicative practices should thus ideally provide opportunities for exposing learners to such environments and impromptu topics. On the other hand, it is also important to help learners learn within their ZPD (Lantolf & Thorne, 2006). Giving learners the ability to control the movement and view angle of the telepresence robot and to self-select the learning content helped address some of the disorientation and stress. More importantly, the mediation (Lantolf & Thorne, 2006) or assistance the learners received from the native speaker supported both their learning about the new environment and their learning of new culture-specific expressions that were useful for talking in and about the environment.

In terms of technical limitations, issues such as coverage and speed of wireless Internet connection and the size, speed, sound volume, and display quality of the telepresence robot could be largely resolved in the near future, considering the continued development of communication technology. Additionally, in cases where intrusion of other people's privacy is of major concern, sites with active pedestrian traffic could be

avoided, more contained sites could be used and permission from those present could be sought, and the video capturing and recording function of the telepresence could be disabled. In this last case, observations or audio recording of participant interactions could be used as alternative data collection methods for research purposes.

Implications for Future Research Design

The findings of this study have useful implications for informing the design principles for future research on using telepresence robots for language learning, some of which we summarize tentatively below.

- The activity site should be chosen based on instructional goals and student interest, with attention to privacy concerns.
- To the extent possible, language learning activities should involve authentic tasks that happen naturally in actual environments of language use and that meet students' learning needs.
- A pre-task activity should be included to orient learners to the features of the telepresence robot and expectations of the language learning task and to build rapport between the learners and activity facilitators.
- Activity facilitators should be aware of the instructional goals and students' learning needs in choosing to maintain or change conversational topics during the activities. They should also be trained to pay attention to learner abilities and difficulties and to offer appropriate support to the leaners when difficulties arise.
- The learning activity may be gamified to maximize learning motivation and engagement.

Conclusion

As an emerging technology, telepresence robots have substantial potential for promoting FL learning by providing remote language learners with virtual access to authentic physical and sociocultural contexts in a target language community. This study constitutes the first step toward understanding the ways in which authentic communicative practices facilitated by telepresence interaction may enhance or hinder language learners' learning experiences. Our findings provide useful information for future designs of language learning activities that integrate telepresence interaction to promote FL learning. As a small-scale exploratory study, the number of participants was small. In own future work, we will conduct larger-scale studies to more systematically examine the affordances of telepresence interaction to support FL learning with more participants, more diverse environments and tasks, and richer data on learner perceptions and learning outcomes.

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Notes

1. For an introduction to Romo, see its Kickstarter page.

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Appendix. Interview Questions

Interview Questions (Language Learner)

1. How do you feel about the procedure of the activity?
2. How do you feel about the interaction between you and the native speaker?
3. How do you feel about the site of the activity?
4. What are the differences between talking to others via a telepresence robot outdoors and face-to-face interaction?
5. What are the differences between talking to others via a telepresence robot outdoors and talking to others via other technology, such as Skype?
6. Have you imagined yourself as an international student at an American university before? How about now?
7. Did you feel any cultural differences between China and the US during the activities?
8. Do you have any suggestions for improving the system?

Interview Questions (Native Speaker)

1. Do you have any experience in teaching English as a second language?
2. Have you used any technology to improve you English before?
3. How do you feel about the process of communication with others via this robot?
4. What are the differences between talking to others via a telepresence robot outdoors and talking to others via Skype at home?
5. Do you feel the telepresence robot is helpful for teaching a foreign language or not?
6. Do you have any suggestions for improving the system?

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