

Acceptance of Telepresence Robots During Group Work

An Experimental Study

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Abstract

Telepresence robots are an emerging technology that enables social interaction between physically dispersed users. In this research, an exploratory study was conducted to get first insights with regard to technical affordances, usability and user acceptance of a telepresence robot in the context of learning related group work. Results indicate that the group work was successful and that it can be worthwhile to employ a telepresence robot for such a usage scenario. Furthermore, the case study identifies technical and social issues, which should be tackled to optimize such group work.

Keywords: Telepresence, Human robot interaction, Technology acceptance, Usability

1 Introduction

Telepresence robots are a further development of videoconference systems. They enable dispersed group members to have a greater sense of social presence during group work and improve social interactions between members in different locations (Nakanishi et al. 2012; Robert & You 2014).

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Research on the employment of telepresence robots in higher education contexts is currently sparse. Tsui et al. (2011) and Newhart (2014) examined the use of telepresence robots in conference room meetings and in a classroom. As a result, the following basic requirements for a telepresence system have been determined: a reliable Internet connection, high quality of video and audio transmission, a user-friendly user interface, and a strong battery service life.

A telepresence robot can be controlled remotely and allows the user to interact naturally with a remote environment (Lewis et al. 2014). The commercial telepresence robot Double¹, which we use, allows this kind of communication in real time. The Double can be described as a type of videoconference on rolls (cf. fig. 1). In fact, it is an iPad on wheels which can be remotely controlled to turn left and right, move forward and backward, look forward or down (with the second camera of the iPad) and raise or lower the iPad's height to emulate a seat or a standing position.



Figure 1. Workgroup



Figure 2. Telepresence User's View

Using a telepresence robot in a higher education environment can hold many advantages as well as challenges of course. Telepresence allows absent students to interact in the remote environment. This means, that sick or unavailable students have a chance to participate in university classes without being physically present. This is the use case for our investigation as described below.

¹ <http://www.doublerobotics.com/>

2 Research design

We were interested in first insights with regard to the requirements and effects of deploying a telepresence robot in a classroom. The pragmatic aim of our exploratory study is to deduce basic recommendations concerning the use of the Double robot in a university environment. We especially aim to identify technical and social issues that need improvement. To achieve this goal, a mixture of methods was used (observation, questionnaire, video analysis, follow-up interview with the Double user) to investigate a learning related group work scenario.

The task of the group was to prepare and give a presentation in the field of advertising and marketing. For three of four sub-tasks, the group was divided into two sub-groups, one interacting with the robot, the other one working without. For the final task (discussing the results), the whole group was reunited. Group interaction was observed by the first author of this paper and recorded on video. Furthermore, two questionnaires, one for the group and one for the telepresence user, were developed based on the following items of the TAM2-model (Venkatesh & Davis 2000): perceived usefulness, perceived ease of use and subjective norm. The content of the TAM2-model was used because it is assumed that the more useful and easy to use a user perceives a new technology, the more positive is his attitude towards using the new technology. Thus, the questionnaires included questions concerning the usability of the Double. Moreover, characteristics of group interaction, the task performance and estimated learning efficiency were observed through video analysis.

3 Analysis

The focus of the analysis is on technological affordances, learning efficiency and acceptance. Details on methods and analysis can be found in (Berisha 2014).

3.1 Technology

Video & audio transmission

Concerning the quality of video transmission, negative as well as positive factors could be observed. The low video resolution, the restricted field of view and the missing zoom function of the Double were proved to be disadvantageous for the user and group interaction. It was impossible for the Double user to read printed text and text written on a whiteboard. However, the group acted pragmatically and sent the material via e-mail. During the task, the Double user was asked if he could see all his group members and he stated “No [...], but it doesn’t matter, I can change [my position]”. The limited field of view made it impossible to see all his group members at the same time (cf. fig. 2). Due to these negative aspects, the remote user could not see and collaborate in the same way as a physically present group member. Nevertheless, the test persons assessed the quality of communication as sufficient. The audio quality was considered acceptable. During the test, it was observed that rustling sounds and quiet speaking of the physically present group members were the reason for short interruptions. Thus, the communication through the Double included several interferences.

User interface (UI)

One of the most important criteria for the introduction of a system is the user interface. The Double user considered the user interface as understandable, intuitive and user-friendly.

Physical characteristics

Concerning the physical characteristics, the height of the Double turned out to be appropriate for the group interaction, because the sitting and stand height were similar to a person. The Double user especially valued the mobility as high and indicated that he was able to move freely around the room.

3.2 Learning efficiency

Distraction

Due to the technical difficulties (e.g. limited field of view) the group members had to help the Double user with task processing. This resulted in a distraction of the whole group. Nevertheless, it was observed that this had only small effects on the quality of the results. Particularly, in the preparation of

the presentation the effort was high. Throughout the test, the physically present members took care of the user and asked questions such as: “Have the files arrived?”, “Can you read that?” and “Should I read that [contents on the whiteboard] again and louder?”.

The physically present group members mentioned that working with the telepresence user involves more work but nonetheless is widely similar to working with a physically present person. Therefore, it can be assumed that the distraction was moderate.

Duration

As already mentioned, the participants were divided into two groups, one of which worked with the Double user. It must be stated that the Double user needed more time to get and read the text to prepare the presentation than the other group members. Moreover, helping him distracted his group members. Therefore, it must be noted that the group interaction with the Double had a disadvantageous effect on learning efficiency.

3.3 Acceptance

Regarding the video and questionnaire evaluation, the perceived usefulness was valued high. On the other hand, due to the technical restrictions, the perceived ease of use was mediocre.

According to TAM2, acceptance depends on the usability of the technology. Furthermore, other variables such as the subjective norm, the intention to use a system and the image of the system are also important (Venkatesh & Davis 2000). All participants, the Double user as well as the physically present group members, had a positive attitude towards using the Double. In addition, every member considered the usefulness of the Double differently. Despite appreciating the usefulness, three group members evaluated the interaction with the Double as impersonal. They indicated that the effort seems too high and some enumerated the disadvantages: “time consuming”, “exhausting”, “disadvantages in terms of the learning material” and “dependence on others”. Just one member found the telepresence system very helpful and positive. She gave a very positive assessment of the group interaction and atmosphere with statements like “[...] good interaction [...]” or “[...] everything possible similar to the physically present members”.

Users were also asked if they were willing to help telepresence users in their everyday university life. While the majority indicated that they would

“of course” help, one user made it a condition of “limited time” and “emergency”.

The Double user reported that he felt ignored and as an outsider. The majority of his group members also clarified that they preferred the physically present members. The video observation confirmed these statements: In some situations, the present group members turned to themselves at first, before turning to the Double user. It can be assumed that the Double user was not completely accepted as an equal group member.

To sum up, different variables affect technology acceptance positively and negatively. In this test, the Double was not fully accepted. Nevertheless, the attitude towards the Double, the entire group culture as well as the results of the group work can be considered as positive and of high quality.

4 Discussion and conclusion

Results indicate a moderate to high value of telepresence robots for synchronous group work with a mixture of physically present team members and one remote user. Group work was functional and successful without fundamental flaws or constraints.

The intuitive user interface, the mobility and the Doubles’s ability to communicate enabled the user to become actively involved in the group work. Consequently, he could, despite technical limitations, successfully interact with his group members in the remote environment.

Beyond that, there is still a difference in the quality of interaction in comparison to face-to-face communication. With regard to this aspect, our investigation identified some technical and social issues, which should be tackled for further optimization.

- The rigid fixed display, which resulted in a limited field of view
- The need of a zoom function (which is established recently by Double Robotics² in form of a software update in combination with the new iPad Air)
- Failures of the audio transmission (an upgrade in form of a purchasable audio kit is available)
- Low video resolution (which has also been improved with the iPad Air)

² <http://blog.doublerobotics.com/announcing-double-app-for-ios-version-2-dot-0>

- Lack of organization: preventive measures for the Double user can help, e.g. providing all learning materials in digital form in advance

Such technical and organizational measures should be applied to enhance the implementation of telepresence settings within university environments. This can lead to a positive image of telepresence in general and of the Double robot in particular, which may produce a higher technology acceptance in the near future.

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