Is a Robot Better than Video for Initiating Remote Social Connections Among Children?

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ABSTRACT
To investigate how children interact differently when interactions are mediated with screen-based video communication versus a robot-mediated communication, we conducted a study with elementary students in Korea, comparing the use of both technologies to introduce classroom students with peer-aged individuals in America. Our findings show that the classroom children showed more positive emotion during certain tasks and exhibited more interest to remote participants in the context of robot-mediated communication than with video-mediated communication.

Categories and Subject Descriptors
H.4.3 Communications Applications: Computer conferencing, teleconferencing, and videoconferencing

General Terms
Human Factors, Languages.

Keywords
Tele-communication; robot-mediated communication; video-mediated communication; non-verbal communication, robotic technology in classroom.

1. INTRODUCTION
When we teach people how to interact with people from other cultures, it is important to explicitly address tacitly held understandings of non-verbal behaviors. However, these types of non-verbal cues can be easily lost in the use of traditional video-conferencing technologies such as Skype, VSee, or Google Hangouts. In this paper, we present a study wherein elementary classroom students in Korea are introduced to and interact with a child in America using screen-based video-mediated communication and robot-mediated communication.

2. BACKGROUND
Videoconferencing technology is increasingly used in classrooms to promote foreign language and cultural education [1][2][3]. While robotic technology is far more novel in classroom settings, the early use of robots to enable distance foreign language instruction has shown that such applications have promise. Some teleoperated robots, for example, are controlled by an English speaking human teacher to communicate with English learners at remote sites [4]. We have been using the teaching assistant robot ROBOSEM, an educational service robot for English learning [5], in sustained long-term use in elementary-level English courses in Korea.

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3. HYPOTHESIS
For the following study, we sought to understand how using a robot as a medium for distance communication (*robot-mediated communication*) will affect the interpersonal attitudes of classroom students towards a remote participant. We felt that using a robot would help classroom students to be more interested in the remote participant than when the remote participant interacts over a more traditional screen-based videoconference setup (*video-mediated communication*).

Hypothesis: Classroom participants will show more interest and empathy in the activity with robot-mediated communication than with video-mediated communication.

4. METHOD
For the video-mediated communication condition, we used Google hangout on a large-screen display located in the classroom in Korea, and on a laptop located in the remote

Figure 1. Classroom children interacting with a remote student using (a) robot-mediated and (b) video-mediated communication

participant's home in the US. For the robot-mediated communication condition, the children in the Korean classroom interacted with a robot featuring a screen showing the remote participant. Children were allowed to move around the classroom as they wished at all times under the two conditions. Each class was 40 minutes long and six experimental classes were conducted in a total of three days shown as Table 1.

Table 1. Participants and conditions

		Day 1	Day 2	Day 3
Classroom participants in classroom (Korea)	**First medium**	Video	Robot	Video
	Second medium	Robot	Video	Robot
	N	1	4	1

In total, there were six elementary students (7 years old, three girls and three boys) in Korea who participated. This resulted in a small participant size of six (n=6) for analysis of the paired t-test.

The questionnaire consisted of three parts: four-point scale (1- strongly disagree, 2- disagree, 3- agree, 4- strongly agree) questions, an emotional journey map, and several open-ended questions.

5. RESULTS

The analysis of data from post-experiment questions and observation notes showed that classroom participants showed significant differences favoring interaction using the robot over video, in interest and intimacy to the remote participant between the video-mediated communication and robot-mediated communication. No significant difference was not found in empathy with media (α=0.1).

We found that classroom participants showed more interest when they interacted with participants through the robot M=3.00, SD=0.80 than when they interacted with participants through the video M=2.50, SD=1.10, T(5)= -1.936, p= 0.055 (α<0.1) as shown in Table 1. We found that classroom participants showed a slight more empathy with media when they interacted with participants through the robot M=3.00, SD =1.60 than when they interacted with participants through the video M=2.83, SD=2.17, T(5)= -.0542, p= 0.305 as shown in Table 2. We found no significant effects of medium or either video or robot on the participant's empathy with media.

Table 2. Difference in each factor

Factor	Video Mean (SD)	Robot Mean (SD)	T (DF)	p-value
Interest	2.50 (1.1)	3.0 (0.8)	-1.936 (5)	0.055*
Empathy with media	2.83 (2.167)	3.0 (1.6)	-.0542 (5)	0.305

CONCLUSION

This paper provides evidence that a robot could improve the quality of social connection particularly in the case of cultural contact, by supporting non-verbal communication with several limitations such as the small number of participants.

The results suggested that classroom participants would be more interested in meeting people from different cultures if the remote participant were introduced via a robot-based communication medium rather than with video conferencing technology. The participants seemed to feel more positive, more familiar, and less inhibited interacting with the robot, which is consistent with what was expected based on a prior literature review.

Our results highlighted the potential for robots to play a valuable role in distance communication and educational potential of such communication. Thus, providing students with a new learning environment and shaping wider implication of robot-mediated communication may be considered in the near future.

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