



Children use non-verbal cues to learn new words from robots as well as people



Jacqueline M. Kory Westlund^{a,*}, Leah Dickens^b, Sooyeon Jeong^a, Paul L. Harris^c, David DeSteno^b, Cynthia L. Breazeal^a

^a MIT Media Lab, 20 Ames St., Cambridge, MA 02139, USA

^b Northeastern University, 360 Huntington Ave., Boston, MA 02115, USA

^c Harvard University, 13 Appian Way, Cambridge, MA 02138, USA

HIGHLIGHTS

- Children followed a robot's gaze and bodily orientation to determine what entity the robot was referring to.
- Children recalled new words equally well whether acquired from a robot or from a human.
- The distinctiveness of the nonverbal cues of both robot and human constrained children's acquisition of new words.

ARTICLE INFO

Article history:

Received 21 July 2016

Received in revised form

3 April 2017

Accepted 10 April 2017

Available online 17 April 2017

Keywords:

Preschool children

Non-verbal cues

Social robots

Word learning

Reference

ABSTRACT

Social robots are innovative new technologies that have considerable potential to support children's education as tutors and learning companions. Given this potential, it behooves us to study the mechanisms by which children learn from social robots, as well as the similarities and differences between children's learning from robots as compared to human partners. In the present study, we examined whether young children will attend to the same nonverbal social cues from a robot as from a human partner during a word learning task, specifically gaze and bodily orientation to an unfamiliar referent. Thirty-six children viewed images of unfamiliar animals with a human and with a robot. The interlocutor (human or robot) oriented toward, and provided names for, some of the animals, and children were given a posttest to assess their recall of the names. We found that children performed equally well on the recall test whether they had been provided with names by the robot or by the human. Moreover, in each case, their performance was constrained by the spatial distinctiveness of nonverbal orientation cues available to determine which animal was being referred to during naming.

© 2017 Elsevier B.V. All rights reserved.

1. Introduction

Social robots are innovative new technologies that have considerable potential to support children's education as tutors and learning companions. Social robots share physical spaces with us and leverage our means of communication – e.g., speech, gestures, gaze, and facial expressions – in order to interact with us in more natural, intuitive ways. They have the potential to combine the general benefits of technology – such as scalability, customization and the easy addition of new content, and student-paced, adaptive software – with the embodied, social world. Prior

research has shown that young children will not only treat social robots as companions and guides [1–3], but will also readily learn new information from them [4–8].

Given this potential, it behooves us to study the mechanisms by which children learn from social robots, as well as the similarities and differences between children's learning from robots as compared to human partners. Some existing work investigates these differences. Kennedy et al. [5] examined the effects of a human tutor versus a humanoid robot tutor on learning prime number categorization with children aged 8–9 years. With both tutors, children's scores on the math task improved from pretest to posttest, but the human led to a greater effect size than the robot. Serholt et al. [9] compared the attitudes, success rate, and help-asking behaviors of children aged 11–15 years during a LEGO construction with either a humanoid robotic tutor or a

* Corresponding author.

E-mail address: jakory@media.mit.edu (J.M. Kory Westlund).

human tutor. They found that while children with either tutor successfully completed the task, children were more likely to ask the human tutor for help, but were more eager to perform well with the robot tutor. These studies suggest that there may be important differences in how children treat human and robot tutors. However, both these studies were performed with older children. There is growing interest in developing social robots as tutors and learning companions for younger children aged 3–6 years (e.g., [4,10,11,6,7]). How might these children respond? Furthermore, Kennedy et al. [5] points out that they did not constrain the human's social behavior. For some kinds of learning tasks such as language learning, social cues may be very important [12,13]. How do social cues impact children's learning from robots versus from humans? Do children respond to social cues from humans and robots in the same way?

In the present study, we examined whether young children will attend to the same social cues from a robot as from a human partner during a word learning task, specifically gaze and bodily orientation toward a novel referent.

Infants and young children are adroit at following another person's gaze and that capacity makes an important contribution to early social cognition. For example, gaze following helps infants and young children to determine what object or event has triggered another's emotion [14,15]. Gaze following can also provide information about the goal of an agent's ongoing action [16]. In addition, following a speaker's gaze can provide information about his or her intended referent, facilitating the task of word learning. Baldwin [17,18] demonstrated the key role of gaze following for language learning in a series of experiments with infants of 19–20 months. When infants heard a novel label, they did not immediately associate it with the object that they were concurrently looking at or exploring. Instead, by following the speaker's line of regard, they were able to determine what object the speaker was attending to and to link the novel name provided by the speaker with that referent. Recent findings have also shown that infants more readily associate names with novel objects if the speaker's gaze is directed to an object that is presented in a distinctive and consistent spatial locus [19]. By implication, infants treat a speaker's gaze direction as a major index of the particular target that is being named by the speaker within a shared space.

Granted the early importance of gaze following in human social interaction, investigators have begun to examine whether, and under what conditions, young children will follow a robot's gaze. Meltzoff, Brooks, Shon and Rao [20] presented 18-month-old infants with a humanoid robot (HOAP-2, manufactured by Fujitsu Laboratories, Japan) that behaved in one of four ways. Infants in the *social interaction* group observed the robot as it interacted with an adult experimenter. In the course of the interaction, the robot answered the adult's questions and the two parties engaged in mutual imitation. By contrast, infants in the three other groups observed an interaction in which the impression of contingent, two-way communication between robot and adult was eliminated, because the adult remained stationary (*passive adult* group) or because the robot remained stationary (*passive robot* group) or because the gestures and utterances of the two parties were not aligned with each other (*robot-adult mismatch* group).

Following this observation period, infants' tendency to follow the gaze and bodily orientation of the robot was assessed. As they faced one another, the robot turned through 45° to look at an object located on either the left or right side of the infant. Infants who had observed the robot engage in social interaction with the adult were likely to shift their gaze to match the target that the robot was looking at, whereas the other three groups responded unsystematically. By implication, having observed the robot's capacity for contingent, social interaction, infants construed the robot as a partner or informant whose gaze signaled targets that were worth looking at.

Granted that infants can and do follow a robot's gaze, it is plausible to ask whether young children will make use of a robot's line of regard when learning new words, as they do with human partners. More specifically, when a robot introduces a name, are children able to use line of regard to determine which particular object the robot is naming and thereby learn the name of the object? To begin to answer this question, O'Connell et al. [21] presented 18-month-old infants with two learning trials involving pairs of novel objects. Infants heard a robot offer a name for one of the paired objects. In the coordinated labeling condition, the robot uttered a novel label only when both the infant and the robot were focused on the same novel object whereas in the discrepant labeling condition, the robot uttered a novel label when focusing on a different object from the infant. Infants were subsequently tested to check if they had associated the name with the appropriate object, notably the object that the robot had focused on. They were shown the two novel objects and asked a comprehension question (e.g., "Where is the dax?").

Analysis of infants' attention during object naming indicated that they adjusted their gaze appropriately depending on the gaze direction of the robot. Thus, in the discrepant labeling condition, infants were prone to shift their gaze so as to focus on the same toy as the robot, a coordination that was present by default in the coordinated labeling condition. Nevertheless, infants performed at chance in the comprehension test following both conditions. By contrast, in a follow-up study, in which a human rather than a robot served as the speaker, infants not only adjusted their gaze, they also performed well in the comprehension test. Finally, in a third study, infants were re-tested with a robot but before proceeding to the word learning phase, they were given an opportunity to watch a 60-s interaction in which the robot's utterances and movements were contingent on the immediately preceding behavior of an adult. Despite this opportunity, infants continued to perform at chance in the comprehension test. Accordingly, O'Connell et al. [21] speculated that despite their tendency to follow the robot's gaze, infants did not think of the robot a reliable or conventional speaker from whom it is appropriate to learn new words.

Two aspects of the study by O'Connell et al. [21] may have led infants to fail to learn new names from the robot. First, it is unclear whether the infants perceived the robot as an interlocutor with whom they could interact. During the familiarization phase, infants had only a brief opportunity to observe the robot communicate with an adult. It moved independently (turned its head) and vocalized (said "hello" and "ooh"). However, this may not have been sufficient for infants to regard the robot as a speaker from whom they could acquire language. Prior research suggests that a speaker's contingent responding to the learner appears to play a key role in early language acquisition. For example, Kuhl [12] found that although infants will readily learn to differentiate new phonemes when they are presented by a live and contingent interlocutor, they fail to do so if they simply observe a video of the same interlocutor engaged in a conversation that is not directed at them. A second concern with the study conducted by O'Connell et al. [21] is that they tested 18-month-olds. In a series of studies, Horst and Samuelson [22] showed that, even at 24 months, infants can use a speaker's gaze to map a novel name onto the appropriate referent but display poor retention of that name on subsequent retention tests.

Accordingly, in the study to be reported, we made two changes aimed at giving the robot the best opportunity to serve as a teacher of language for young children. First, guided by previous research, we tested older children. Second, we sought to ensure that the robot would be perceived as a contingently responsive interlocutor for both the child and the experimenter in the context of an initial three-way conversation. We describe these two changes in more detail below.

Download English Version:

<https://daneshyari.com/en/article/4931254>

Download Persian Version:

<https://daneshyari.com/article/4931254>

[Daneshyari.com](https://daneshyari.com)