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Robots as social learners

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Abstract

As personal robots enter the social environments of our workplaces and homes, it will be important for them to be able to learn from a wide demographic of people. Our research seeks to identify simple, natural, and prevalent human teaching cues as well as social-cognitive mechanisms that are useful for directing the attention of robot learners so they can learn efficiently and effectively from these interactions.

This research goal is significant for several reasons. First, most people do not have expertise in robotics or machine learning techniques and therefore are not willing or able to tune parameters, label data sets, specify evaluation functions, or otherwise structure the learning task for the robot learner via technical means. Second, personal robots will have to learn new tasks and skills within the bounds of human attention and patience. Third, people bring a lifetime of experience in learning from and teaching others. Through social interaction, they naturally structure appropriate learning environments and interactions for each other to learn efficiently and effectively. Personal robots should be equipped with social cognitive skills to leverage these social interactions to learn efficiently and effectively from people.

In this talk, we present our research in human-robot interaction that concerns the structure of social behavior, embodied interaction, and social-cognitive skills that we term ``social filters.'' Namely, the myriad of ways in which external social interaction and internal social-cognitive skills mediate the interaction of attention with learning. Social filters can be social-cognitive capabilities such as perspective taking that focuses the robot's attention on the subset of the problem space that is important to the teacher. This constrained attention allows the robot to overcome ambiguity and incompleteness that can often be present in human demonstrations and thus learn what the teacher intends to teach. Other social filters can be external, dynamic, embodied cues through which the teacher uses his or her body to spatially structure the learning environment to direct the attention of the learner. Our challenge is to identify what cues people use, how they employ them, and how they might be leveraged by the robot's social-cognitive mechanisms to efficiently guide the robot's internal attention and learning processes. We report on a series of empirical investigations of human teaching and learning behavior to identify such cues and their use. We then present a set of "social filters" that we have implemented within the cognitive architecture of the robot to demonstrate and evaluate the robot's ability to learn tasks from human demonstration and guidance.

Short bio

Cynthia Breazeal is an Associate Professor of Media Arts and Sciences at MIT, where she founded and directs the Personal Robots Group (formerly Robotic Life Group) at the Media Lab and also co-directs the Center for Future Storytelling. She is a pioneer of Social Robotics and Human Robot Interaction (HRI). Her research program focuses on developing the principles, techniques, and technologies for personal robots. She has developed numerous robotic creatures ranging from small hexapod robots, to embedding robotic technologies into familiar everyday artifacts, to creating highly expressive humanoids, including the well-known Kismet. Ongoing research includes the development of socially intelligent robot partners that interact with humans in human-centric terms, and how HRI can be applied to enhance human behavior as applied to motor learning and cognitive performance.