Randi Williams Hae Won Park Cynthia Breazeal

# A is for Artificial Intelligence

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Personal Robots Group, MIT Media Lab



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# Children eagerly engage with Al, but have faulty assumptions about how it works.

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BACKGROUND

# theory of mind

# the ability to infer the mental states

## Premack & Woodruff, 1978

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#### BACKGROUND

## **Children's Theory-of-Mind Development**



Henry Wellman, David Liu, "Scaling Theory-of-Mind Tasks" 2004

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# Exploring Al topics by programming, training, and interacting with social robot learning companions.

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Randi Williams, Lauren Oh, Hae Won Park, Cynthia Breazeal "PopBots" 2019



### POPBOTS



You tell the robot that strawberries and tomatoes go in the good group. Then you

ask the robot where to put chocolate. What will the robot think?

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How did developmental factors impact what children could learn about AI?

How did learning about AI change children's

perceptions of thinking machines?

THEORY-OF-MIND

AI ASSESSMENT

PERCEPTION OF ROBOTS

01:00

### **Perception of Robots Assessment**



- 1. Robots are like toys Robots are like people
- 2. Robots always follow rules Robots never follow rules
- 3. I am smarter than robots Robots are smarter than me
- 4. Robots cannot learn new things Robots can learn new things
- 5. Robots are like children Robots are like adults

Stefania Druga\*, Randi Williams\*, Mitch Resnick, Cynthia Breazeal, "Hey Google, Is It OK If I Eat You?" 2017

### **Overview of Study Procedure**



# 80 Participants | 4-6-Years Old

10-15 Mins | Pre-K and Kindergarten







#### **RESULTS**

### **Children Did Well on the AI Assessments**



The median score was 70% and the average was 66.8%

Pre-K students (M=59%) did worse than Kindergarteners (M=71%). p=0.011

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## **Age Differences in Understanding AI Concepts**



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### **AI Assessments & Theory-of-Mind**

Some of the AI Assessment questions required social reasoning. We expected that children with lower ToM scores would struggle with them.



**Predicting Behavior:** "The robot thinks that Sally will play paper next. What will the robot play so that it can beat Sally? Rock, paper, or scissors?"

CONTENT FALSE BELIEF

EXPLICIT FALSE BELIEF

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CONTENT FALSE BELIEF

EXPLICIT FALSE BELIEF



**Tricky Supervised Machine Learning (SML):** "You put ice cream in the good (healthy) category and bananas in the bad (unhealthy) category. What category will the robot put corn in?".



CONTENT FALSE BELIEF

EXPLICIT FALSE BELIEF

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**RESULTS** 

## **Observing A Boost in Children's Theory-of-Mind Skills**



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## Children Who Did Better on AI Assessment Appreciated Robots' Cognition More



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### RESULTS

## Children Who Did Worse on AI Assessment Did Not Think Robots Were Smart



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# **Key Takeaways**



Young children learned AI concepts through social interaction



Children leveraged and surpassed their Theory-of-Mind skills

Learning about artificial intelligence caused children to relate to technology more as an intellectual other

# **Thank You!**

Somerville Public Schools Students and Teachers Shady Hill School Students and Teachers MIT Personal Robots Group Graduate Students and Undergraduate Researchers

Jennifer Madiedo, Ara Adakhari

Samsung No Business No Limits NSF Graduate Research Fellowship



## **A is for Artificial Intelligence**

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MIT Media Lab

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## What Do Children Think About Thinking Machines?







Stefania Druga\*, Randi Williams\*, Mitch Resnick, Cynthia Breazeal, "Hey Google, Is It OK If I Eat You?" 2017

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Children do not have the tools to understand how this new technology works

### "Alexa, what do sloths eat?"

"I'm sorry. I don't know how to help you with that."

"That's okay," she exclaimed.

Picking up a second Amazon Echo, "I'll see if the other Alexa knows."

Paraphrased from "Hey Google, Is It OK If I Eat You?" Druga et al. 2017

### BACKGROUND



# AI Activities Overview

Each AI activity was designed to introduce AI concepts while reinforcing other life skills

ΑCTIVITY	MAIN AI CONCEPT	AI CO- CONCEPTS	LIFE SKILLS
ROCK PAPER SCISSORS	KNOWLEDGE BASED SYSTEMS	Reinforcement Learning, Training Set	Sportsmanship, Learning by Practice
ROBOT REMIX	GENERATIVE AI	Probability & Randomness, Modelling	Music Composition, Music and Emotion, Turn- Taking
FOOD SORT	SUPERVISED ML	Nearest Neighbors, Classification	Un/healthy Foods, Sorting

### **Teaching AI to 4 to 6-Year-Olds**



# Rule-Based Expert Systems







# Supervised Machine Learning





## **Children's Theory-of-Mind Development**



Henry Wellman, David Liu, "Scaling Theoryof-Mind Tasks" 2004

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## **Theory-Of-Mind Assessment**



Assesses children's cognitive perspective-taking ability

- Knowledge Access
- Content False belief
- Explicit False Belief

### Knowledge Access Questions

Does Polly know that there is a dog inside the drawer?



Did Polly look inside the drawer?



*Wellman, H. M., & Liu, D. (2004). "Scaling of theory-of-mind tasks." Child development* 

#### RESULTS

### **Children's Theory of Mind Results as Expected**



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### **Children's Perceptions of Robots Pre-Test**

Question	Proportion of Responses					
	🗖 Di	sagree	🗆 Neutral	🗖 Agree		
Robots can learn	15%	19%			66%	
Robots always follow the rules	3%	35%			62%	
Robots are more like people than toys	11%		60	]%	29%	
Robots are smarter than me	21%			62%	17%	
Robots are more like children than adults	10%		45%		45%	

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### RESULTS

## **Children's Perceptions of Robots Post-Test**



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