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Preschooler's Understanding of Robots in Comparison with Familiar Entities

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Ontological categories, such as the animate and inanimate categories, are important structures in children's knowledge acquisition and development. Understanding these categories aids children in making important distinctions. For example, preschoolers attribute different properties to living and non-living things, (e.g., Gelman, Spelke, & Meck, 1983). One question is how this distinction affects reasoning about more complex inanimates, such as robots, which have features of both living and non-living kinds. Robots have anthropomorphic properties including arms and eyes, and yet they are made of metal. Thus, preschoolers have various options for dealing with these objects. They may recruit knowledge of living and non-living objects by assigning these entities solely to either category, or they may selectively borrow properties from each, developing a mixed model that incorporates properties of both categories.

To investigate these possibilities, we asked preschoolers about animate and inanimate properties of robots. 3- and 4-year-olds viewed pictures of two robots, a true animate (e.g., a little girl) and a familiar artifact (e.g., a video camera). Children were asked yes/no questions about animate and inanimate properties of each item.

Analysis of the yes responses was done through difference scores, comparing responses to the robots with that of the familiar items. Results showed that 4 year olds made a clear distinction between the robot and girl for both biological and mechanical properties in the expected direction, and responses for the camera and the robots did not differ for either question type. 3 year olds made these distinctions as well, but they were not as strong, and 3 year olds also had difficulty completing the task. Additionally, many 3 year olds did not even distinguish the girl and the camera clearly, thus suggesting that overall they are still struggling with these categories.

These findings suggest that preschool children did assimilate robots to a single category. However, this first study, along with others (e.g. Woods et al., 2004), uses a visual medium through which children can perceive robots. Yet, with the rapid pace at which technology is advancing, robots are no longer experienced solely through television or pictures, but first hand in households as well. Additionally, other aspects of robots, such as self-perpetuated movement, and the ability to interact with their environment, or even other humans, were not investigated in the first study. Therefore, in a second study, we investigate children's understanding of these technologies.

In this study, 4 and 5-year old children participated, as these children would have a stronger understanding of the animate and inanimate categories than 3 year olds. We exposed children to a live robot where there was no visible human controller, and the robot appears to move of its own accord. This presented children with a strong indication that the robot is engaging in self-directed actions. We then asked children about the psychological, biological, and mechanical properties of the robot, a true animate (a person, who was in the room), and a familiar artifact (a television that was in the room). For psychological properties and biological properties, 4-year-old children placed the robot in between the person and the TV. 4- year-olds attributed mechanical properties to the robot and the television at equal levels, while the person was attributed low amounts of mechanical properties. This pattern of responding was different from the first study, suggesting that factors other than appearance may come into play when children categorize robots. This study suggests that viewing a live robot engage in self-directed action was sufficient to lead 4-year-olds to attribute biological and psychological properties to the robot at higher levels than a more familiar artifact. Despite this, children still maintain a clear difference between a human and a robot at all levels of questioning, and 5-year-old children, while having a similar pattern, had a much lower level of attribution of biological and psychological properties to the robot.

One remaining question is what children will do if the degree to which they believe they are controlling the robot is manipulated. In particular, what if they are given a remote or they view another person controlling the robot? The prediction here is that children will use the property of control to categorize the robot, and they will give it less animate properties if it is controlled by another person or themselves. Follow-up studies will investigate this possibility. This research not only helps us understand children's conceptions of interactive technology, but it also helps develop a more general approach to understanding how children incorporate novel concepts that cross-cut existing ontological kinds. It will yield better understanding of existing ontological categories and how children incorporate new categories into their knowledge.