

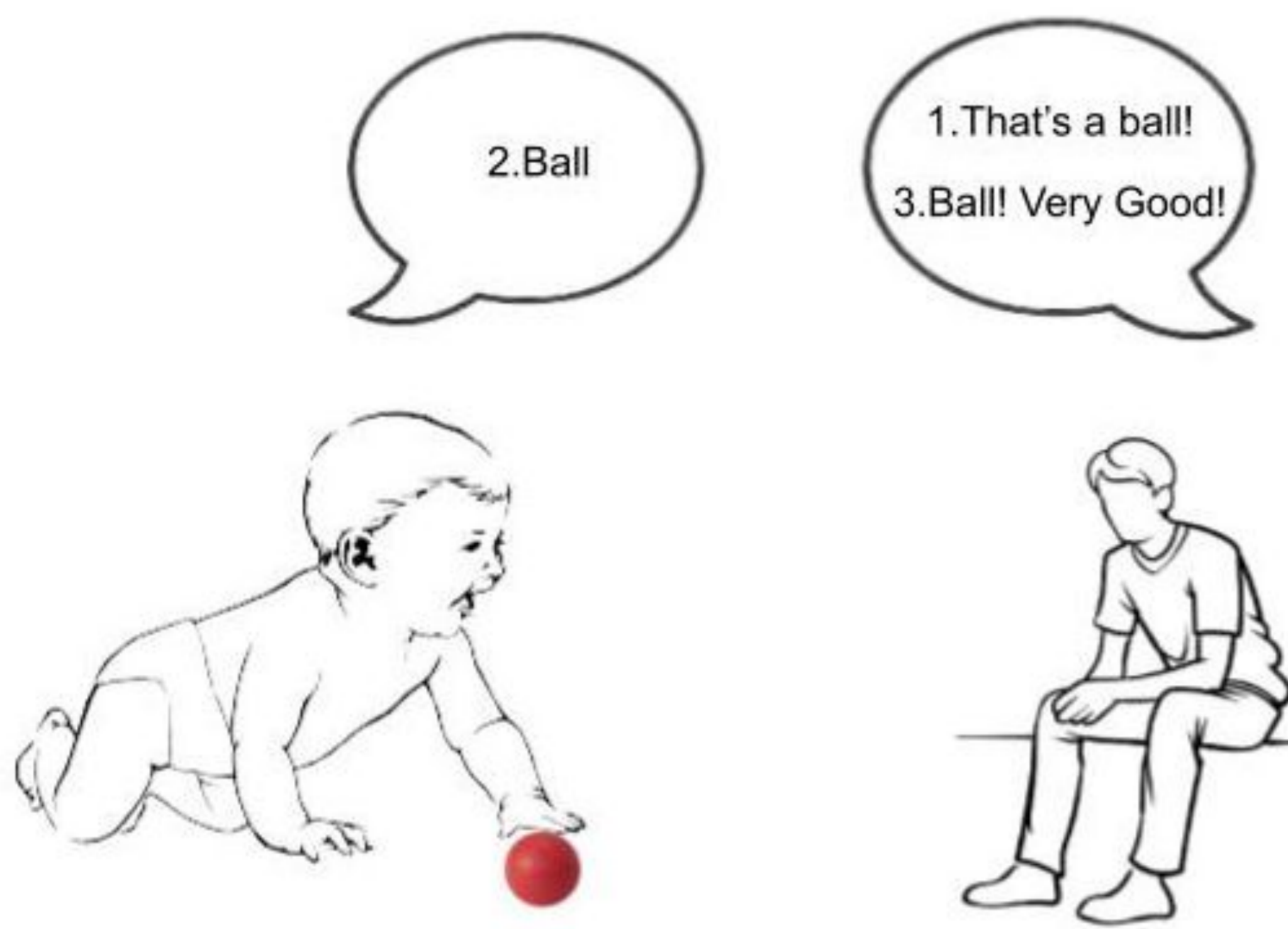
# Symbol and Communicative Grounding Through Object Permanence

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## Grounding and Object Permanence

- Following Larsson (2018), communicative grounding is the process of sharing information in a dialogue (Clark, 1996) and symbol grounding is the establishment of connections between language and the perceptual, physical world (Harnad, 1990).



- A lack of object permanence means out of sight out of mind
- There is very little work that has explored how object permanence plays a role in the communicative and symbol grounding process.
- A robot can “understand” object permanence using Simultaneous Localization and Mapping (SLAM)

## Motivation

- Spoken dialogue systems (SDS) today are limited
- Infants learn language very quickly due to certain behaviors and actions
- An important part of communication is symbol and communicative grounding
- An understanding of object permanence is a critical ability that allows symbol and communicative grounding to take place
- Goal: Improve language learning abilities of SDS using object permanence**

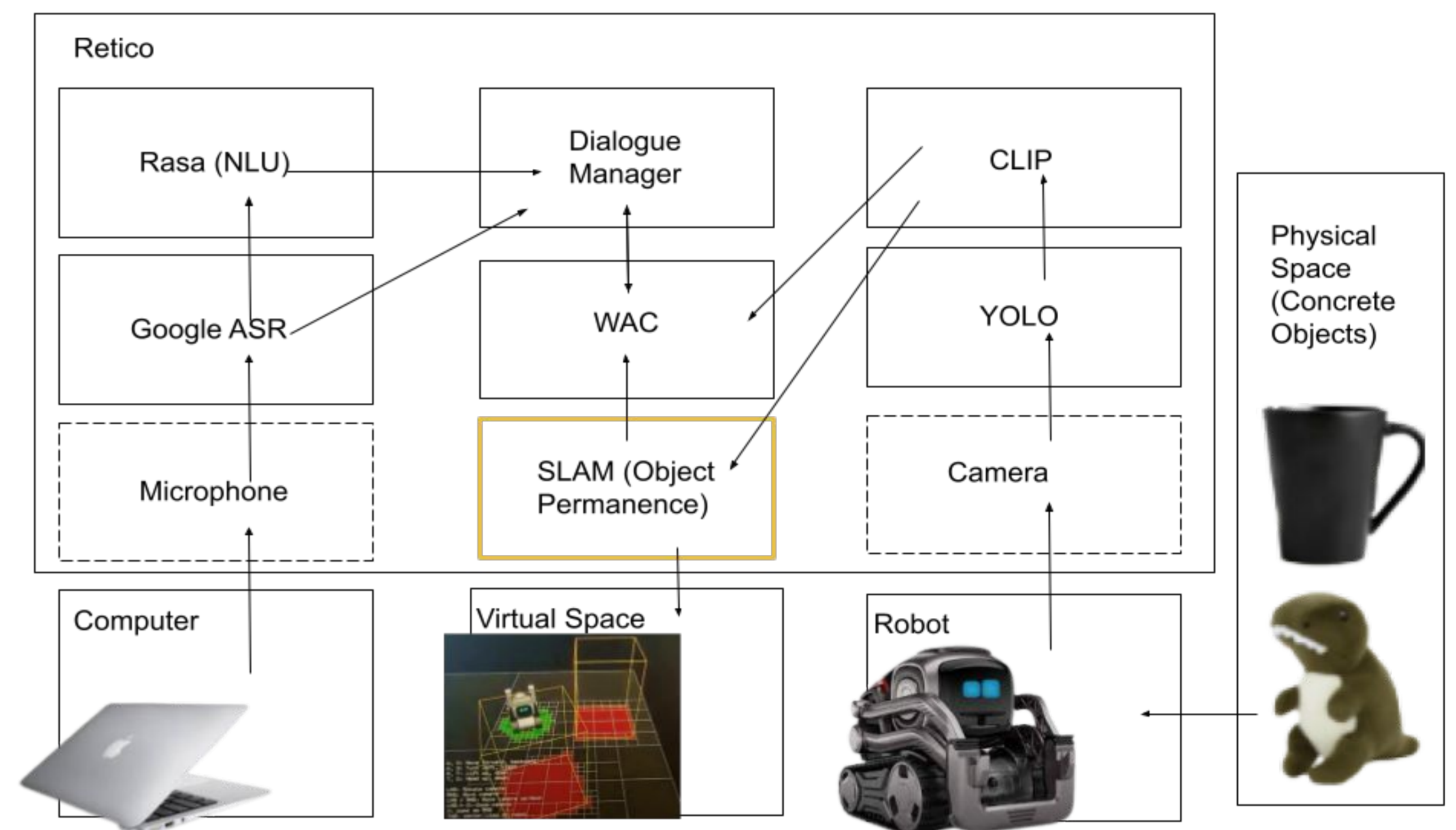
## Gathering Data

- We tasked humans to interact with the Digital Dream Labs Cozmo robot and “teach” it words both with and without an “understanding” of object permanence
- We used a survey to measure the perceptions of the human participants in order to establish that communicative grounding took place
- We measured the number of words that the robot “learned” during the interaction to determine if symbol grounding took place

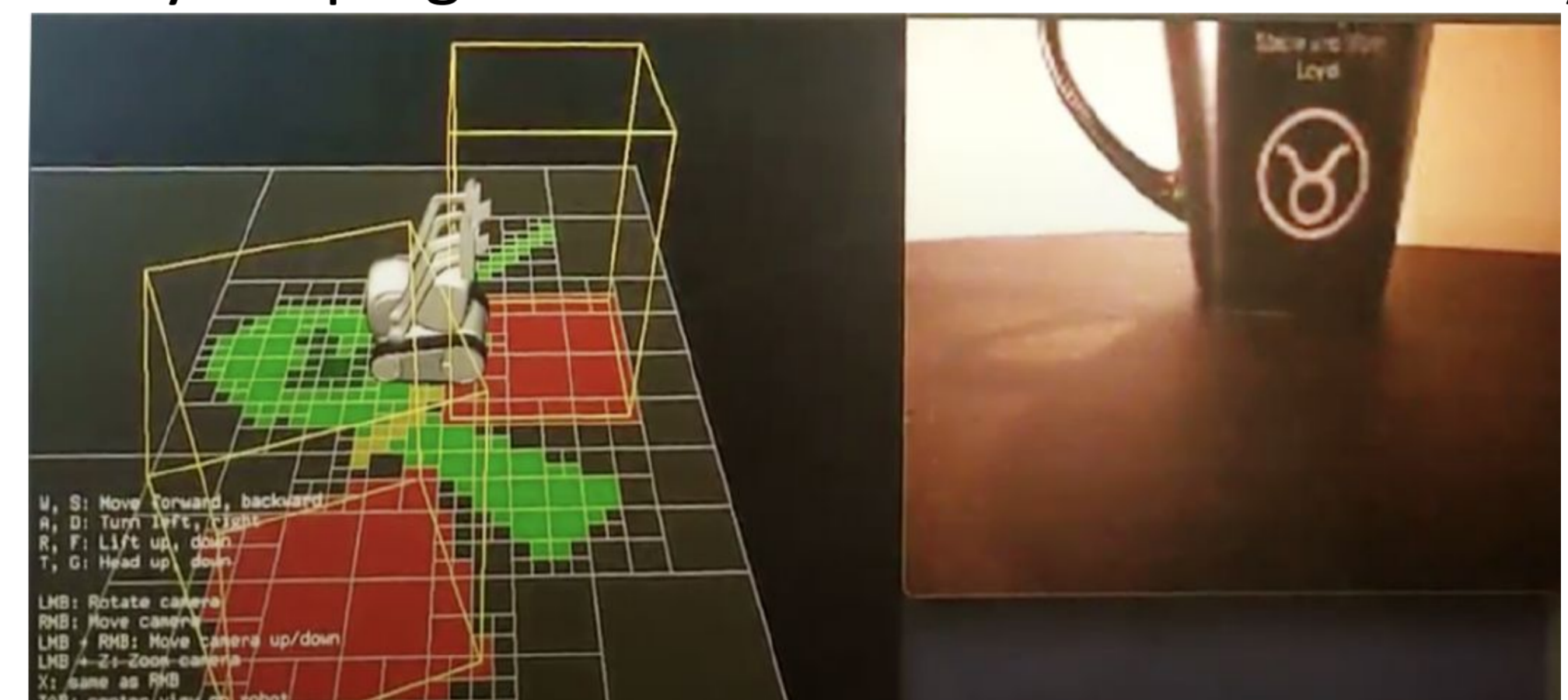


## Design

- Moore and Melzoff (1999) suggested that as early as four months, a child begins to recognize that objects have permanence
- An incremental dialogue system with no prior exposure to language was designed as infants learn and process language this way
- Modules used was able to transcribe and understand speech, detect and gain a concrete understanding of objects, and form an understanding of object permanence

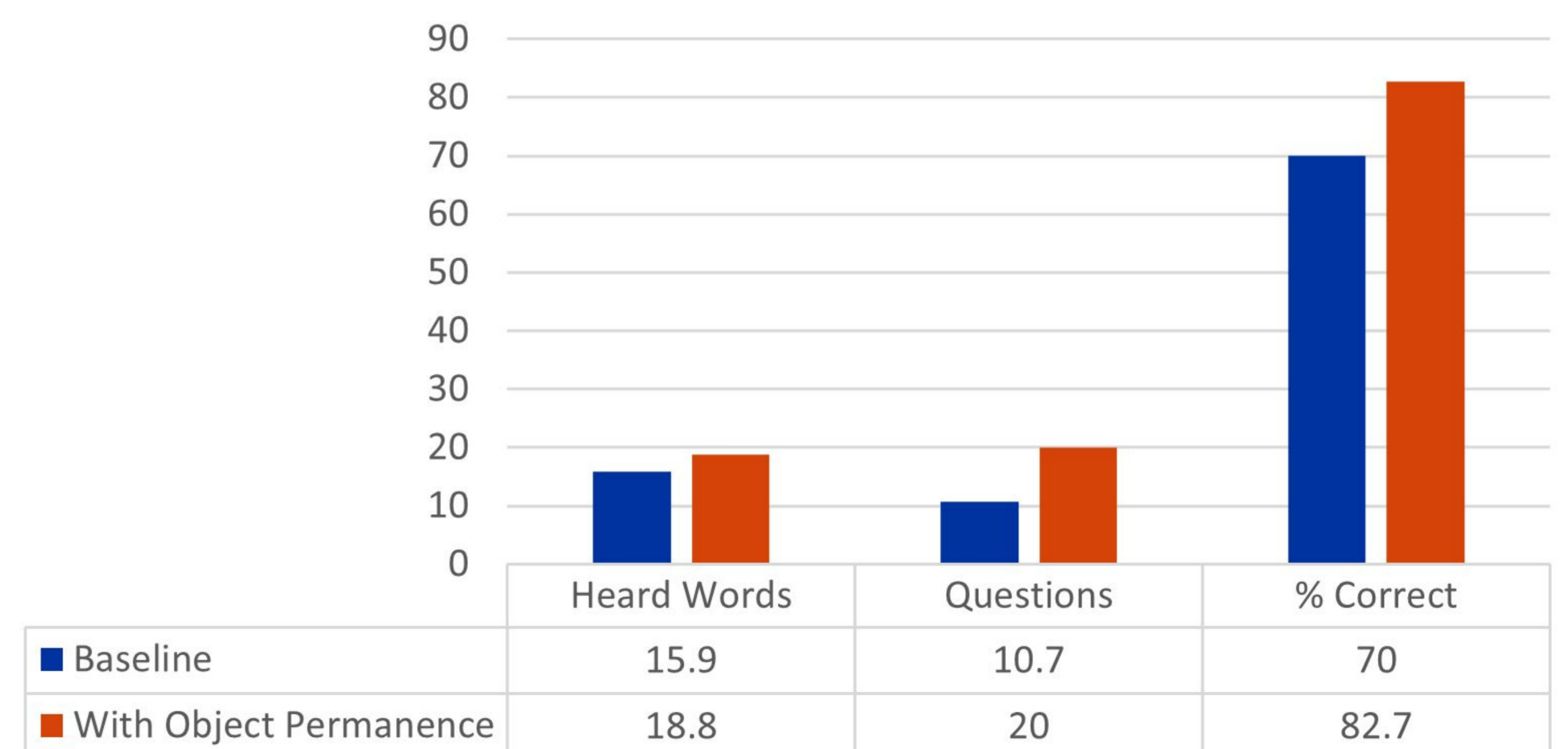


- Object permanence is crucial to symbol grounding as it allows the formation of mental images which our SDS will do using SLAM (constructing or updating a map of an unknown environment while simultaneously keeping track of Cozmo's location within it)



## Results

Average Performance on Language Acquisition Task



- With object permanence Cozmo is perceived to learn language better than without object permanence

## References

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