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USC Institute for Creative Technologies

# The Bot Language Project:
## Moving Towards Natural Dialogue with Robots

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# A quick introduction

- Cassidy Henry, computational phonologist

UCLA

B.A. Linguistics
*June 2018*

ARL

CISD
SMART Scholar
*Since June 2016*

SMART
SCIENCE, MATHEMATICS & RESEARCH FOR TRANSFORMATION
PART OF THE NATIONAL DEFENSE EDUCATION PROGRAM

UNIVERSITY OF MARYLAND

PhD, Linguistics
*Starting Fall 2018*


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# Project Goals

- **Goal:** to provide more natural ways for humans to communicate with robots
  - In order to reach this, we need systems that meet human expectations of communication/interaction
  - To investigate this, we are collecting dialogue in human-robot interactions


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# Motivation

- **Human-robot teaming:** *leveraging all participants' unique strengths*
  - *Humans* can see, reason and command
  - *Robots* can follow instructions well, handle dangerous environments and situations, and employ use of sensors
- Effective teaming demands effective communication: *detailed, efficient, and flexible*
  - Natural language does this!
- Method by which humans communicate and collaborate: **language!**

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# Research Questions

How can we explore the ***natural diversity*** of communication strategies, while collecting language ***in a form that a robot could use***?


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# Let's peek behind the curtains…

- As mentioned before, we need to start with humans…without an extant system to test on!
- **Workaround:** employing Wizard-of-Oz (WoZ) setup for handling dialogue and navigation


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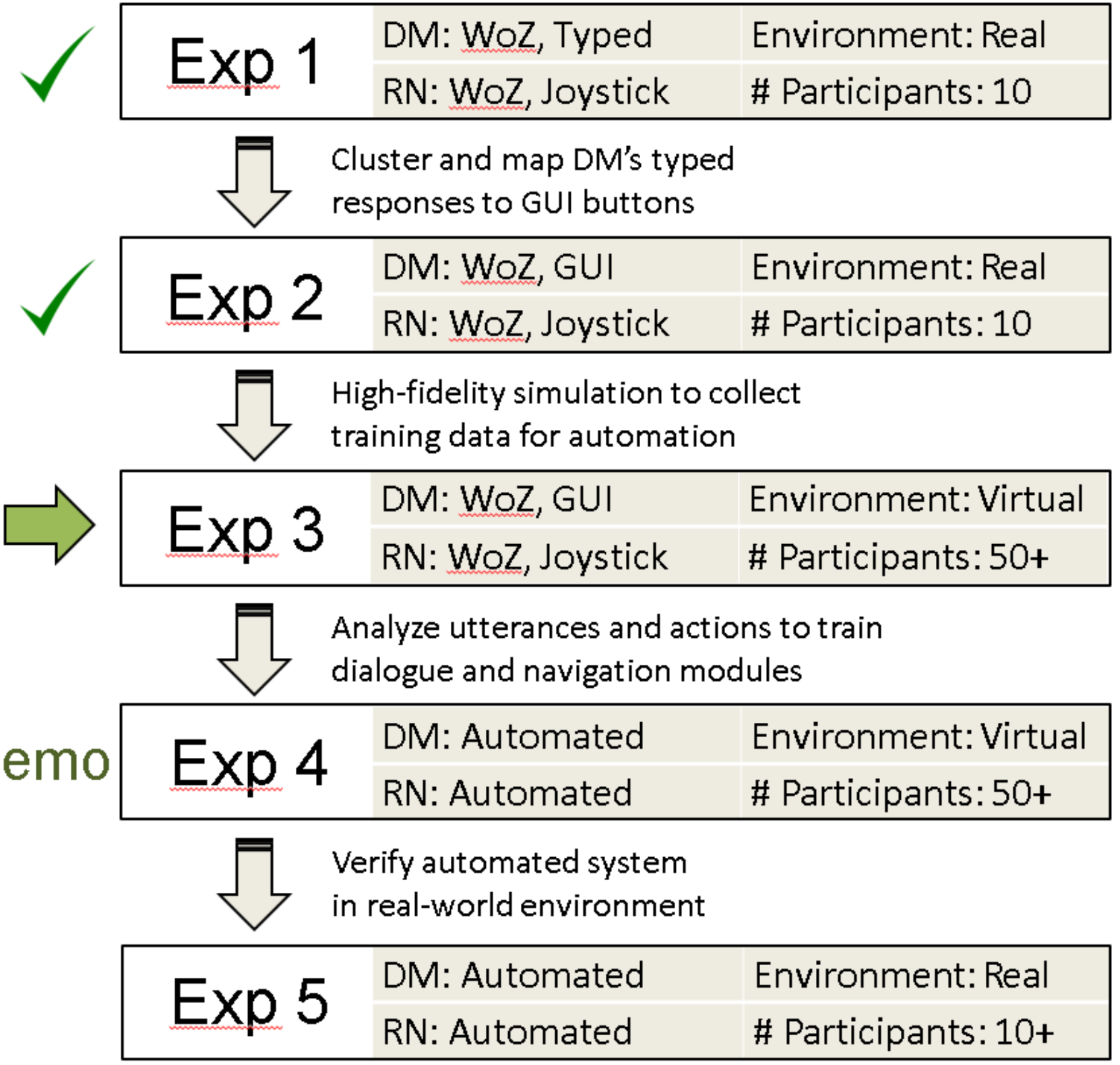
# Experiment Progression

- Experiments (Exp) build towards DM and RN automation
- Begin in using **Wizard-of-Oz (WoZ)** methodology with two human wizards standing in as robot AI to collect data for training an initial system

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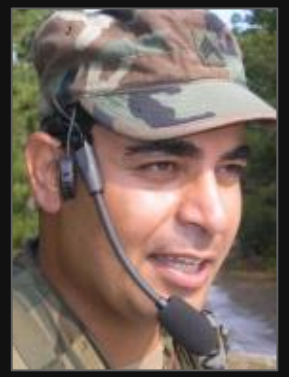
# Example Interaction



DM

RN

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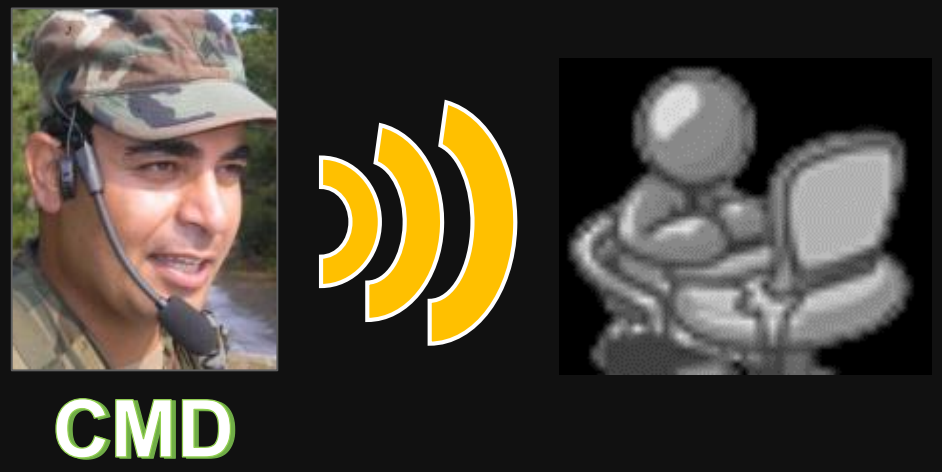
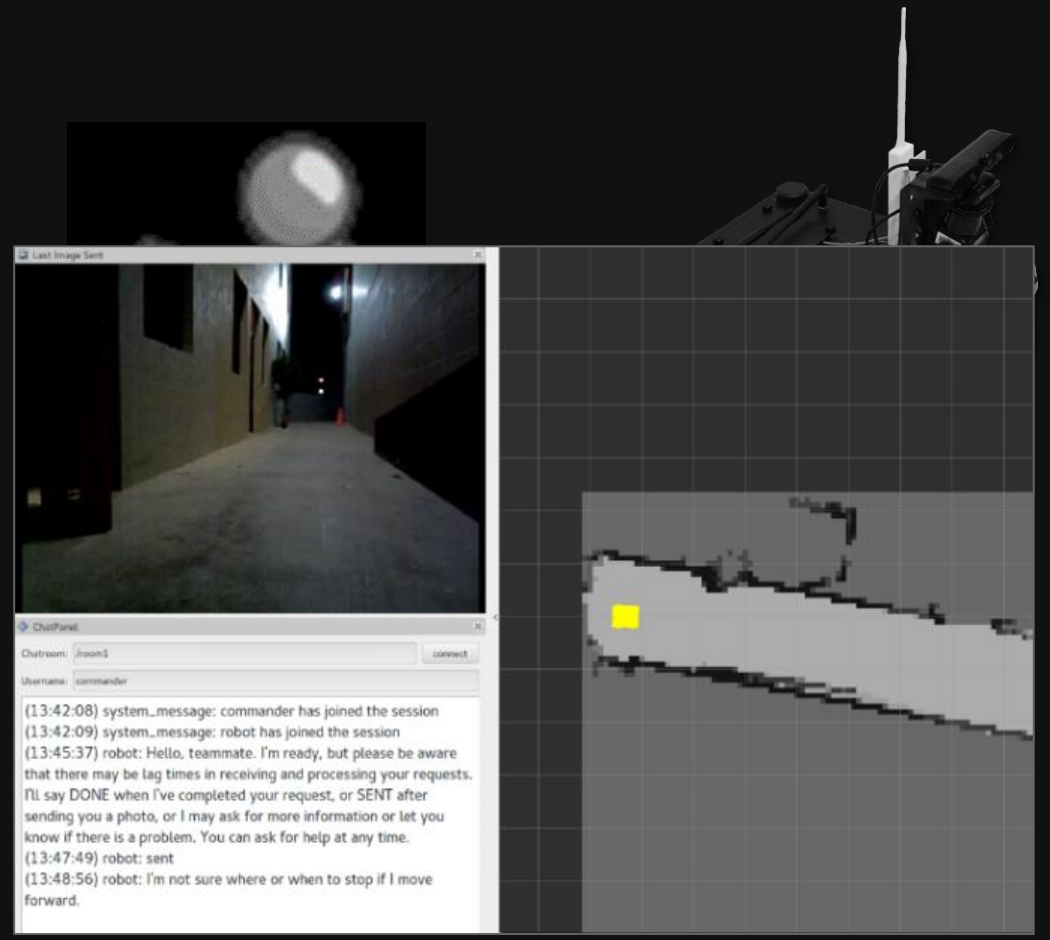
# Commander




**Commander – Human Participant**

- Verbally Instructs a Robot
- Sees text message responses, LIDAR map, and images sent from onboard robot



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# Wizard #1 – Dialogue Manager

**Dialogue Manager Wizard (DM-Wizard, DM)**

- Handles all language functions of "robot"
- Responds to CMD and robot navigator (RN) via text message
- Serves as mediator between  RN and CMD


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# Wizard #2 – Robot Navigator

**Robot Navigator Wizard (RN-Wizard, RN)**

- Handles all navigation function of "robot"
  - Constrained language received -> joysticks robot
- Separation of wizards:
  - reduces cognitive load/wizard labor
  - removes intuition of interpreting commands


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# Example Interaction

DM

RN

Proceed forward


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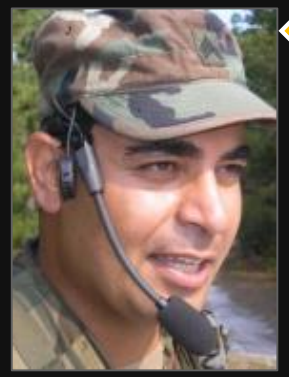
# Example Interaction



DM

RN

How far? You can tell me to move to an object that you see, or a distance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# Example Interaction

DM

RN

Proceed forward three feet


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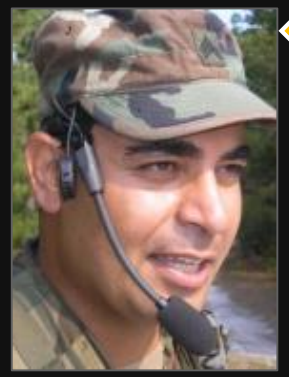
# Example Interaction



DM

RN

Executing…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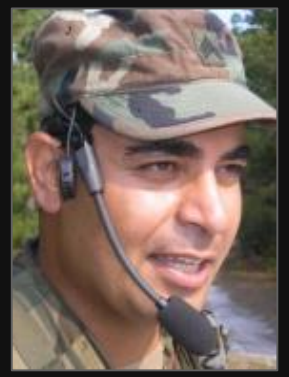
# Example Interaction



DM

RN

move forward
three feet

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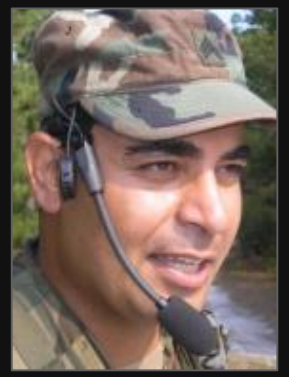
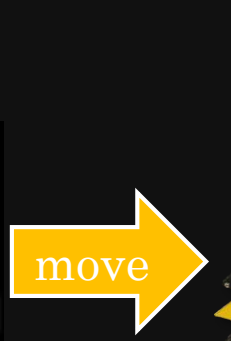
# Example Interaction



DM

RN



*moves robot forward 3 feet*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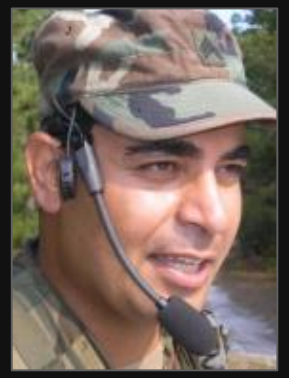

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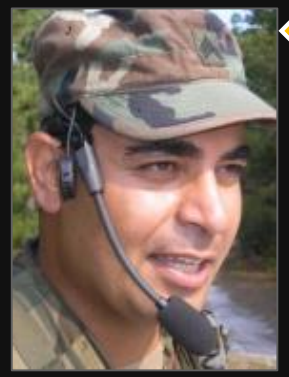

DM

RN

done


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# Data - Transcripts

- **Time aligned transcripts of 4 data streams**
  - 2 audio streams
    - CMD and RN
  - 2 text streams
    - DM->CMD, DM->RN
- **Two conversational floors present**

Time

| Commander (Audio Stream 1) | DM->Commander (Chat Room 1) | DM->RN (Chat Room 2) | RN (Audio Stream 2) |
|---|---|---|---|
| face the doorway on your right | | | |
| and take a picture | | | |
| | there's a door ahead of me on the right and one just behind me on the right. which would you like me to face? | | |
| the door ahead of you on the right | | | |
| | | move to face the door ahead of you on the right, image | |
| | executing... | | |
| | | | image sent |
| | sent | | |


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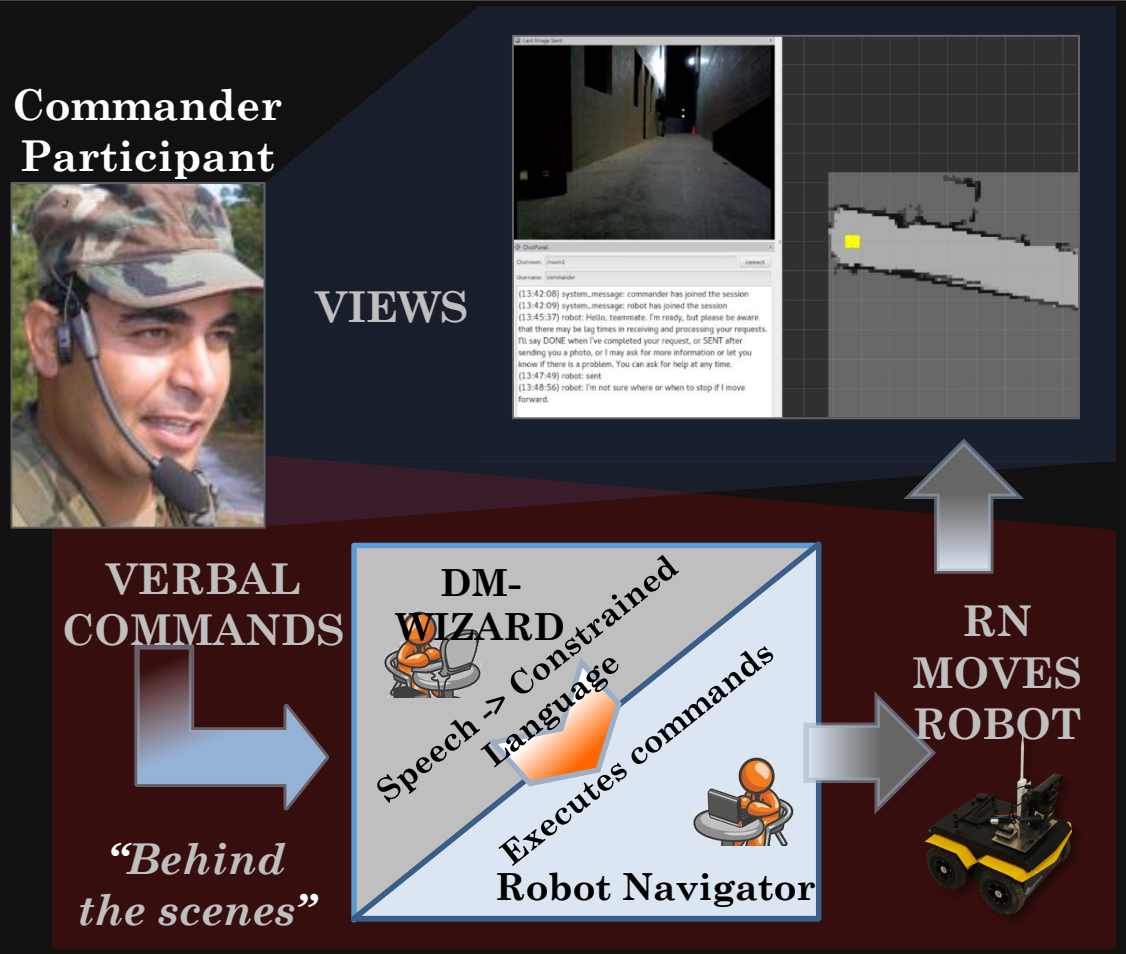
# Multifloor Setup

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|---|---|---|---|
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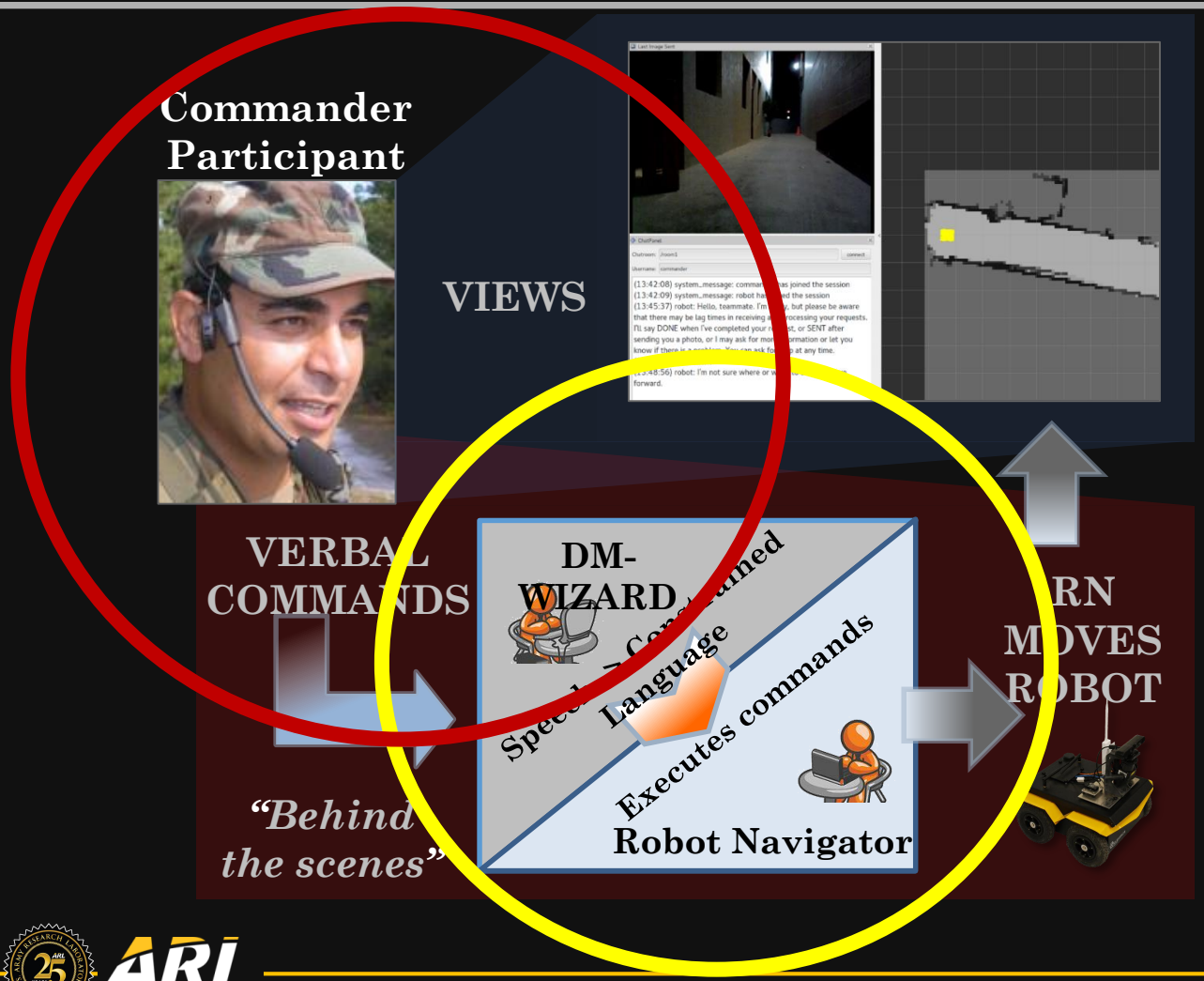


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| | sent | | |



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# Corpus Statistics

- **20** participants
- **~20** hours of audio
- **3,573** utterances from commanders
- **5,154** utterances from DM
- **2,727** utterances from RN


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# Some Insights

- **Developed novel annotation schema** for dialogue structure in multi-floor communication (forthcoming LREC 2018)
  - Allows us to track information flow and evaluate dialogue efficiency

- **Noting trends of communication styles**
  - Sociolinguistic, paralinguistic variations
  - Use of landmark (e.g. doorway, hallways) vs metric (e.g. five feet) (RoboNLP Vancouver CA 2017)
  - Uses of deixis/referential modes of communication
  - **…and much more!**


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# Future work

- Progressing towards automated robot dialogue system, using our data
- Spoken command translation to executable actions (HRI 2018) and understanding human intention behind commands
- Collecting language in as varied situations as possible for fuller coverage of language that can arise
- …and more!


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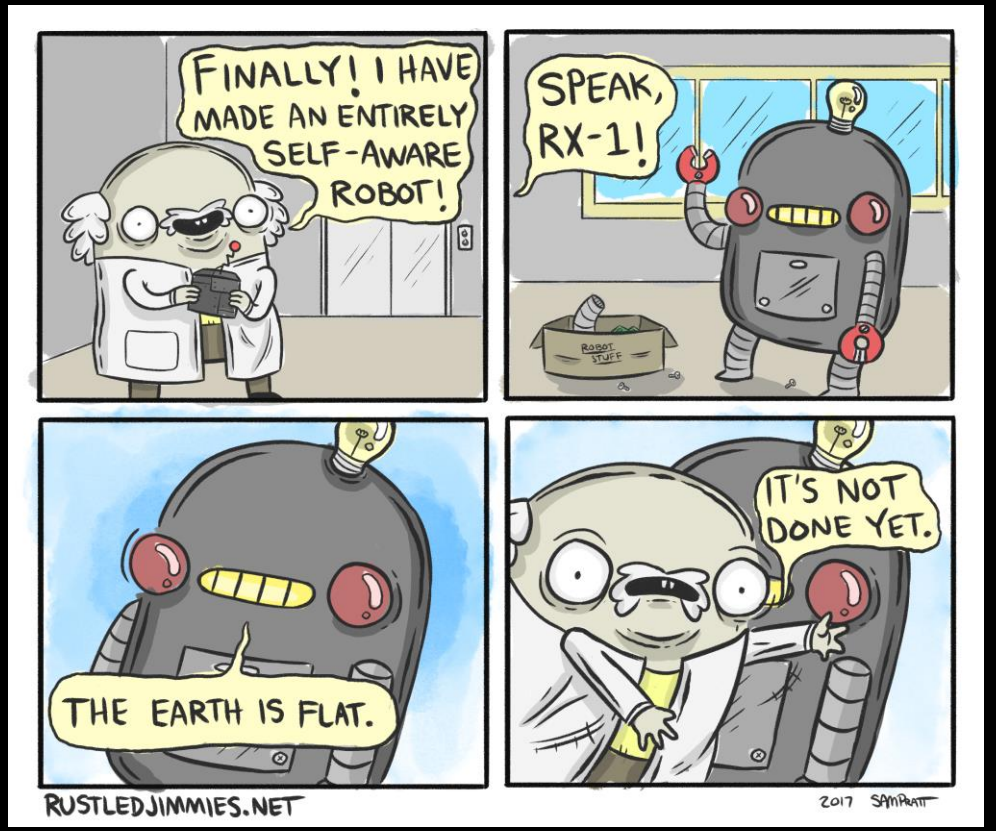
# Any questions?

- Dataset to be released
- Collaboration opportunities:
  arl.army.mil/opencampus/

Or talk to Stephanie Lukin at our poster later today!





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