

# Pre-Presentation Notes

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Slides and presentation materials are available online at:

**[karlwiegand.com/csun2014](http://karlwiegand.com/csun2014)**

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# **RSVP-iconCHAT:**

## **A Single-Switch, Icon-Based AAC Interface**



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**Northeastern University (USA)**  
March 1, 2013

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# Outline

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1. The Vision
  2. Background and Scope
  3. Approach
  4. Evaluation
  5. Results
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# Part 1: **The Vision**

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# Brain-Computer Interfaces (BCI)

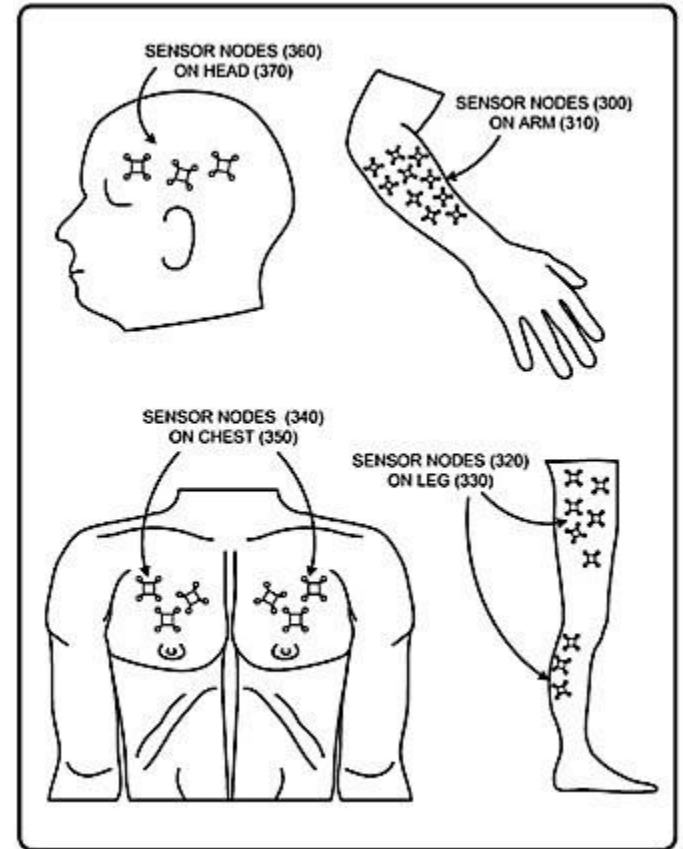
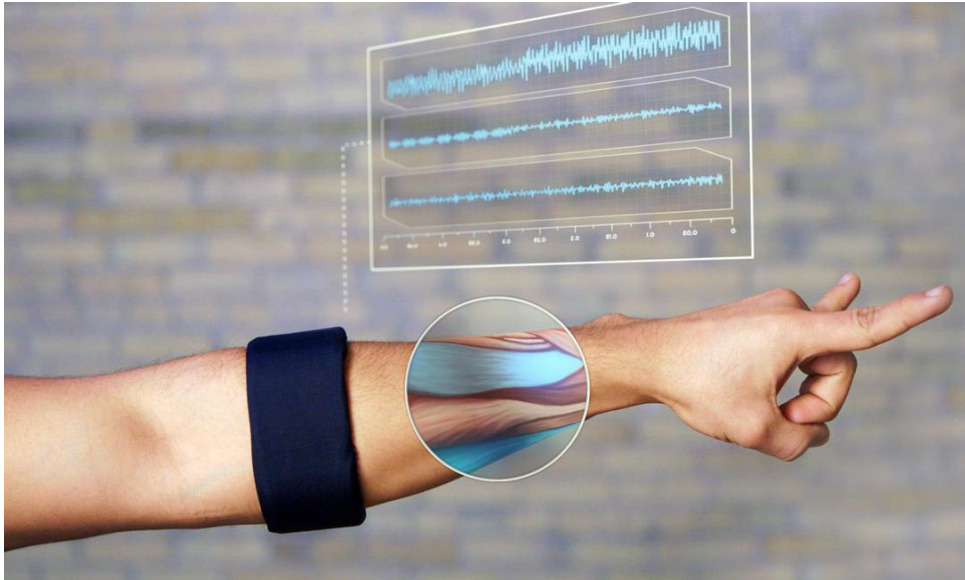
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<http://www.emotiv.com/>  
<http://www.neurosky.com/>

# Muscle-Computer Interfaces (MuCI)

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<http://www.thalmic.com/en/myo/>

<http://research.microsoft.com/en-us/um/redmond/groups/cue/MuCI/>

# Wearable Computing Systems

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[http://www.vuzix.com/consumer/products\\_m100/](http://www.vuzix.com/consumer/products_m100/)  
<http://www.google.com/glass/>

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How can we think about  
the future of AAC interfaces?

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Part 2:

# **Background and Scope**

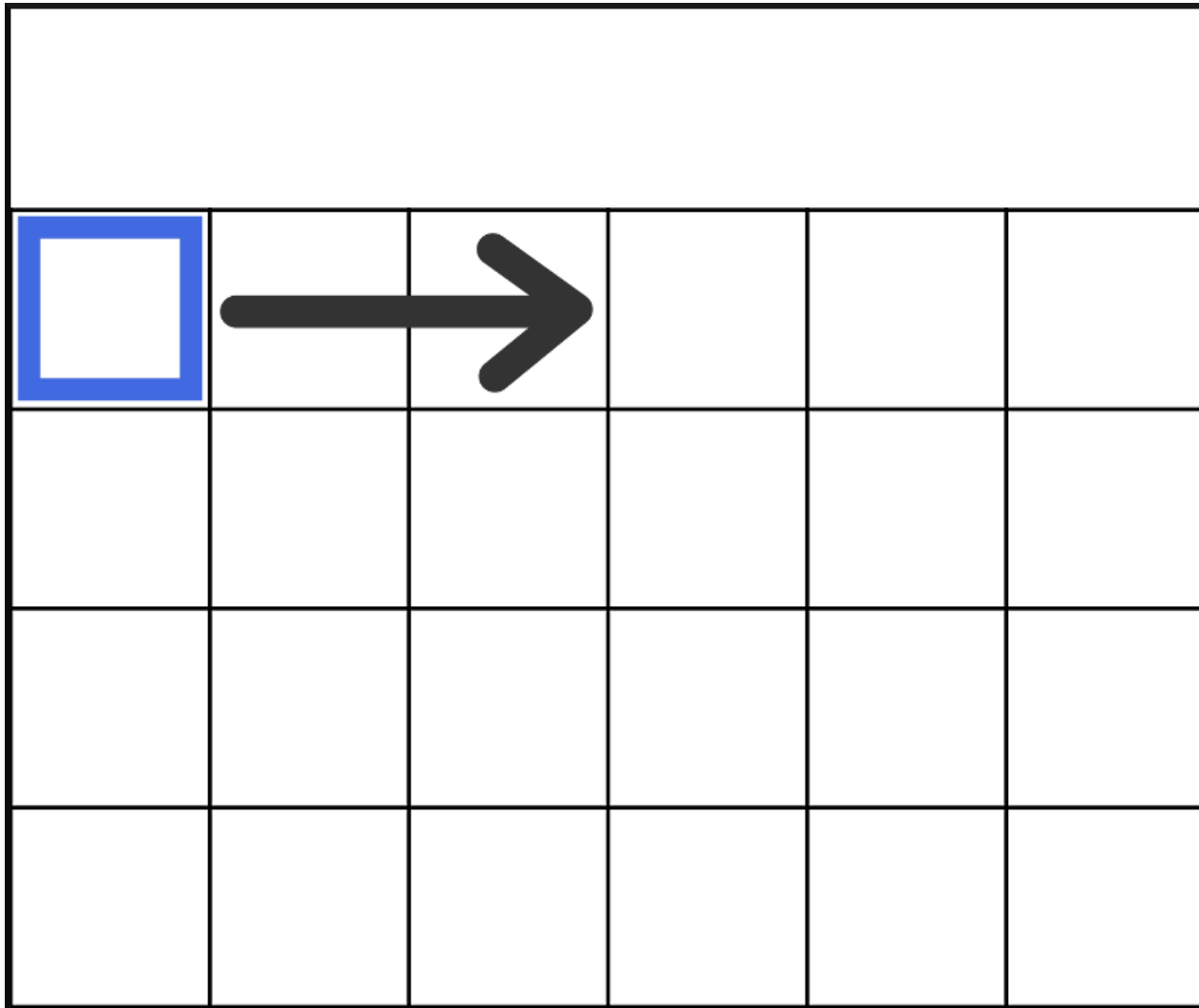
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# Current AAC Interfaces

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# Conversion to Single-Switch

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## A 6x4 grid with a blue border around the top row and a downward arrow in the fourth column of the second row. The grid is composed of 24 cells arranged in 6 rows and 4 columns. The top row is highlighted with a thick blue border. A large black arrow points downwards from the center of the second row, fourth column cell.

# Observations

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1. Maintains familiarity.
  2. Focus is on the vocabulary.
  3. Required screen size is tied to vocabulary size or navigation complexity.
  4. Users usually perform the search twice.
  5. Searches involve repetitive movements.
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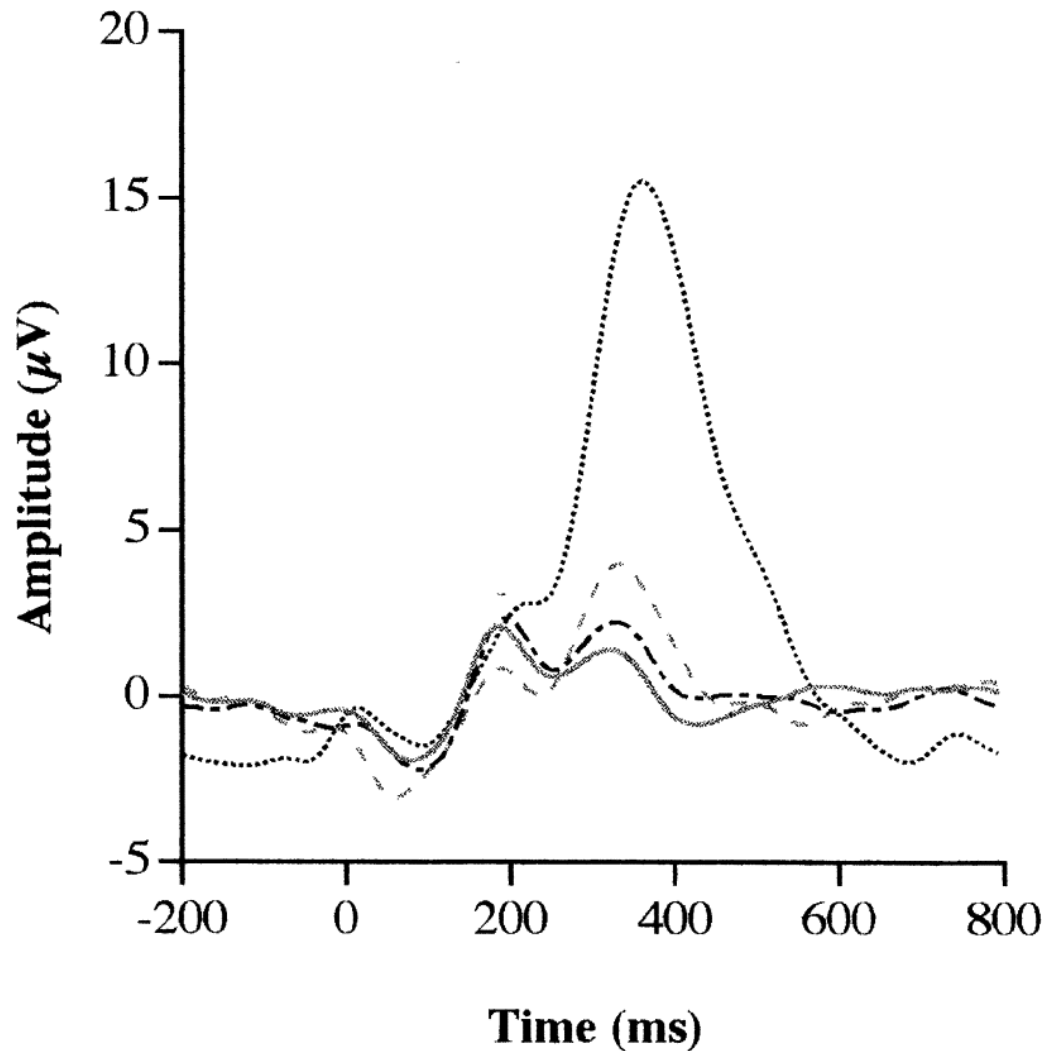
# Our Collaborative Effort

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- Creation of a icon-based, BCI-controlled AAC system
  - NSF Grant HCC-0914808
  - Jointly investigated:
    - Dr. Deniz Erdogmus (ECE)
    - Dr. Rupal Patel (SLPA and CCIS)
  - BCI uses P300 brainwave (unary signal)
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# The P300 Wave

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# Requirements and Scope

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1. Based on icons, not letters:
    - a. Some letter-based BCI systems exist.
    - b. Icons have the potential to be faster.
    - c. Users may be pre-literate or have language impairments.
  2. Minimize head, neck, and eye movements:
    - a. Movement can dislodge the BCI equipment.
  3. Work with a unary signal (P300):
    - a. Expand to support other signals if available.
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# Part 3: **Approach**

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# Driving Questions

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- How can we decouple the required screen size from the vocabulary size?
  - Can we focus on the message instead of the vocabulary?
  - How much work can be shifted from the user to the system?
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# Idea #1: RSVP

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- Rapid Serial Visual Presentation
- Used in psychology, speed-reading, lie detection, and prior letter-based AAC



## Idea #2: Semantic Frames

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- Semantic frames, CxG, and PAS (Fillmore)

*To Give ( Agent, Object, Beneficiary )*

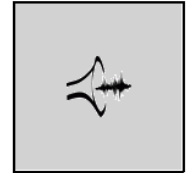
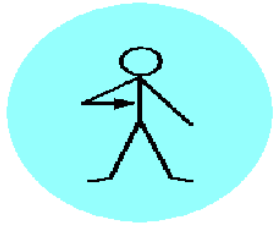
"I gave the item to him."

"The item was given to him by me."

- WordNet, FrameNet, "Read the Web," NELL
  - Easier to convert from semantic to surface
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# RSVP-iconCHAT

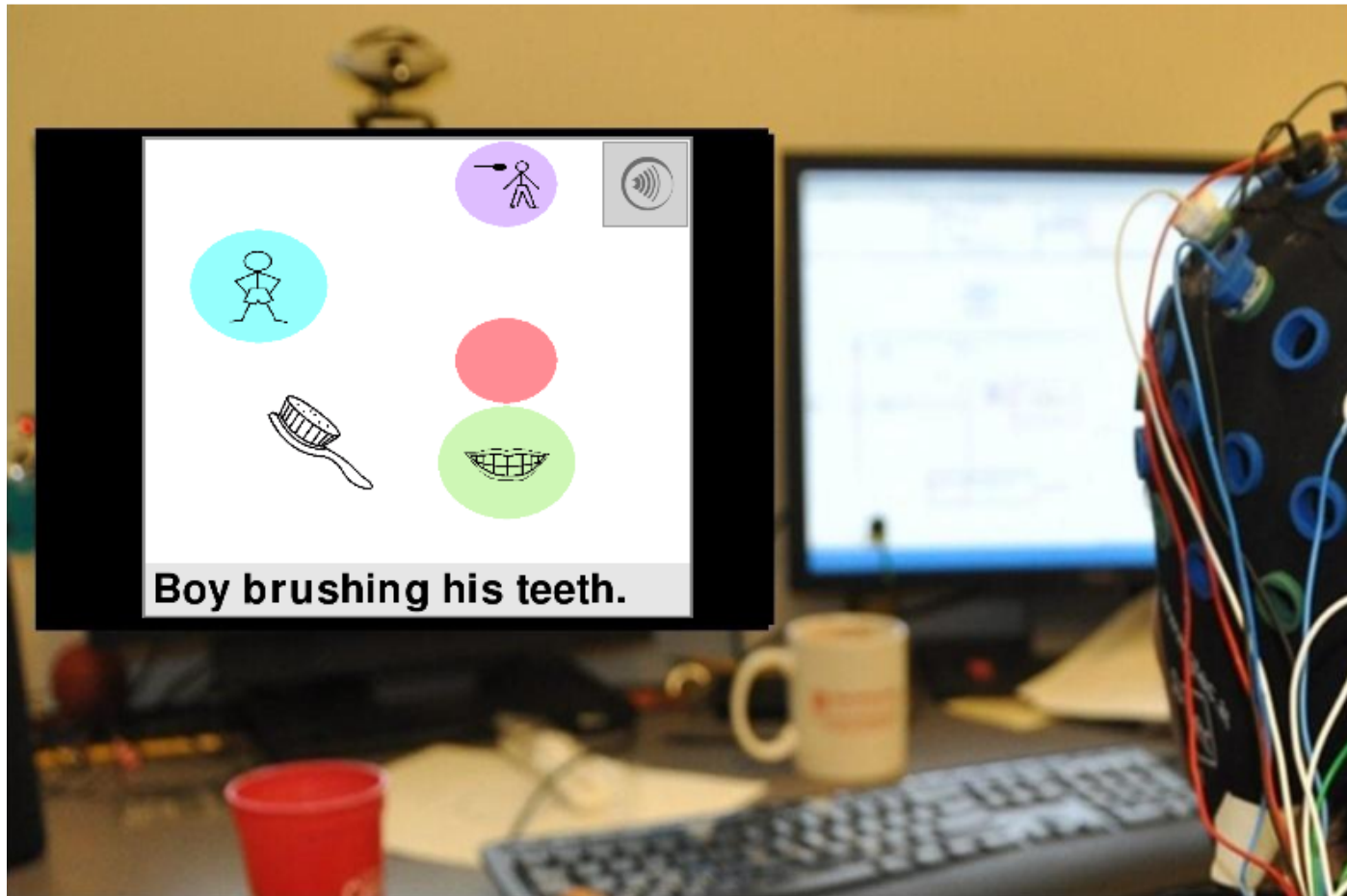
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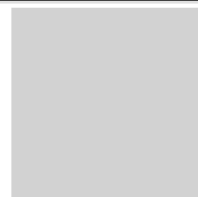
**I wear my blue shirt.**

# Example Usage

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Wiegand, K., Patel, R., & Erdogmus, D. (2010). Leveraging Semantic Frames and Serial Icon Presentation for Message Construction. ISAAC Conference for Augmentative and Alternative Communication, Barcelona, Spain, July 2010.



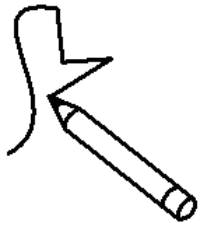
**Cook.**

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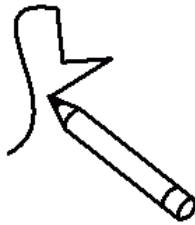
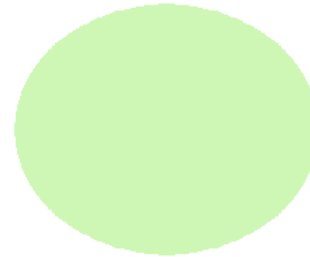
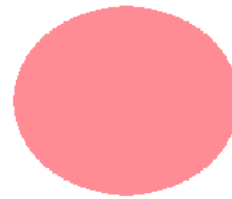
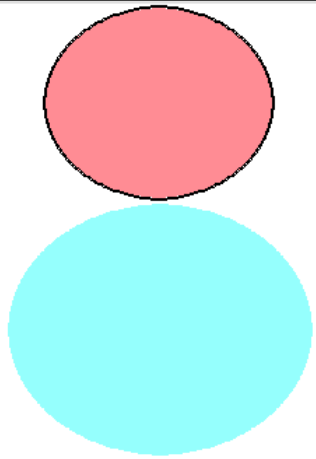
**Wear.**





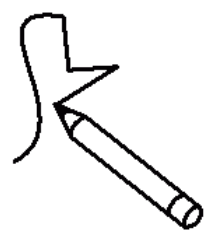
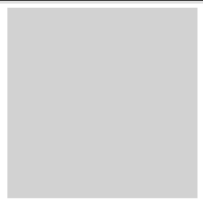
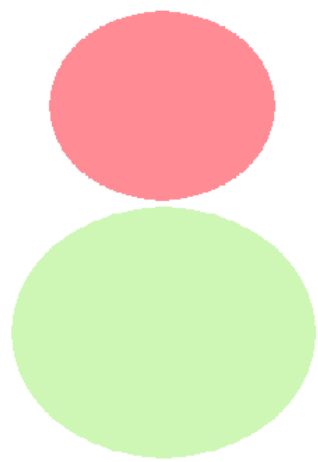
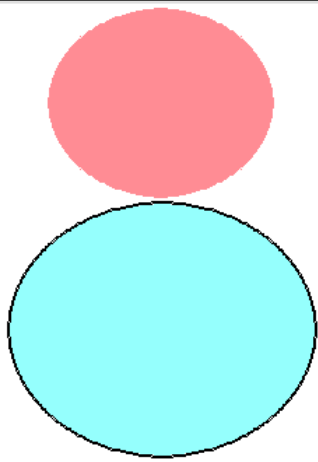
**Draw.**

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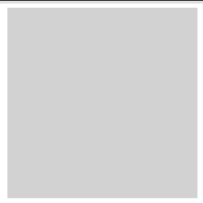
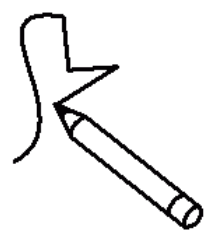
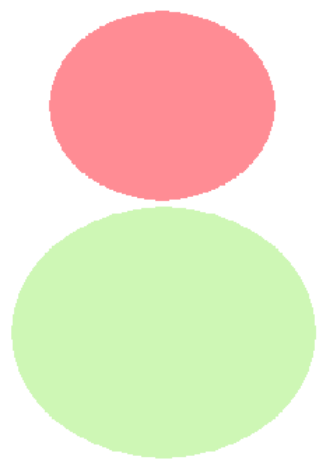
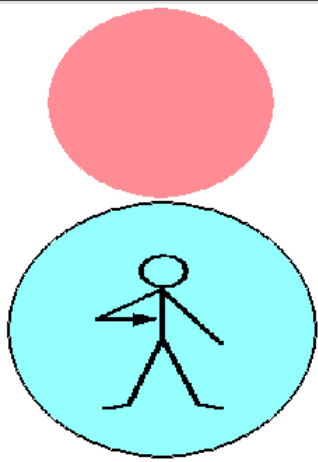


**Draw.**

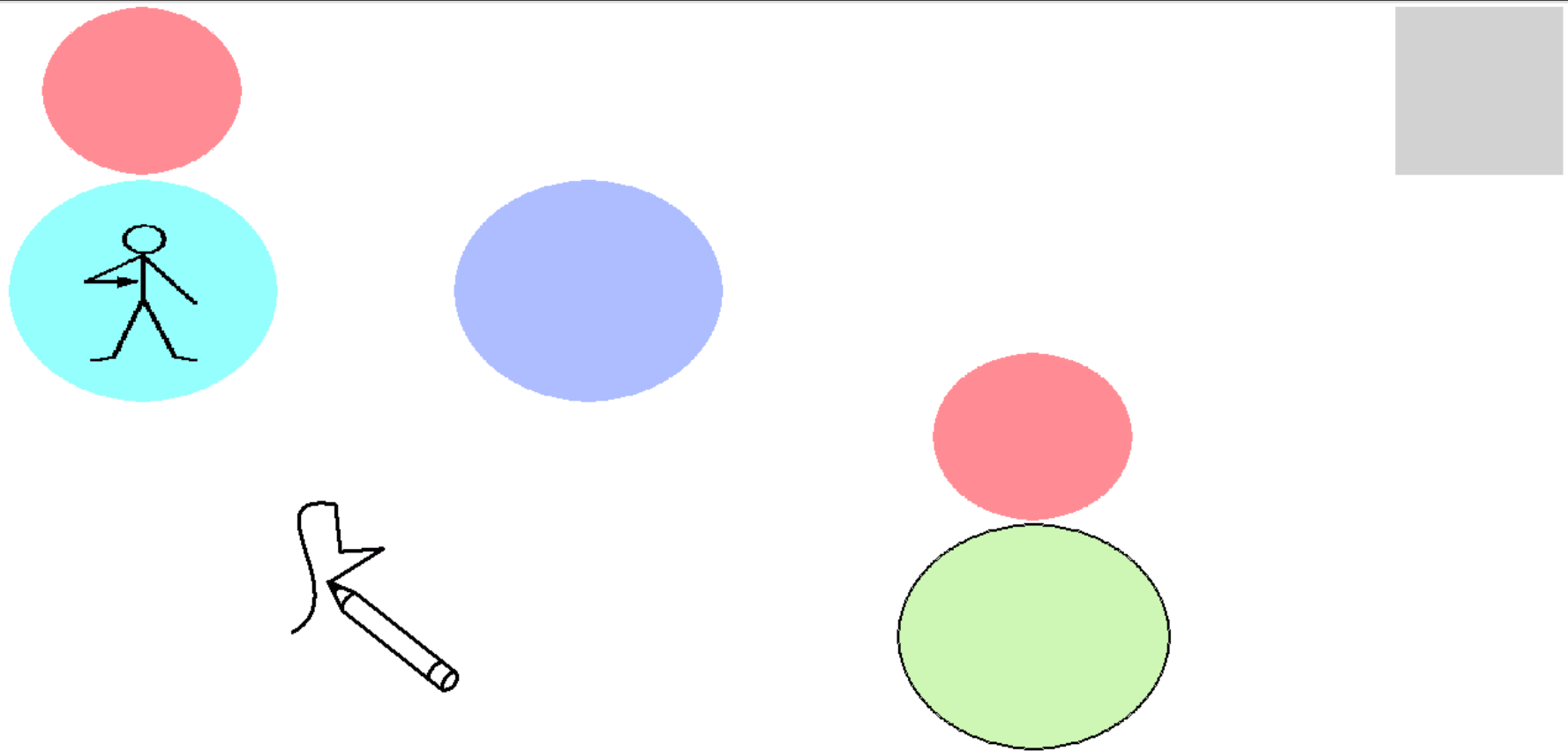
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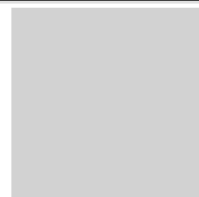
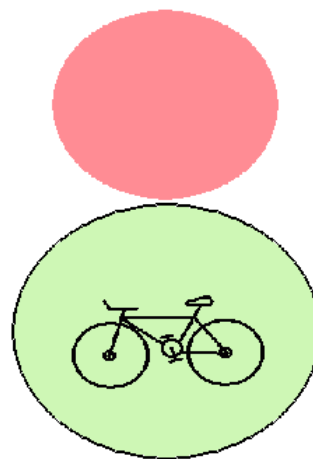
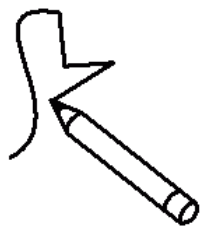
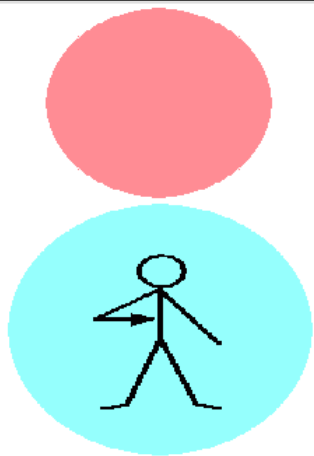
**Draw.**



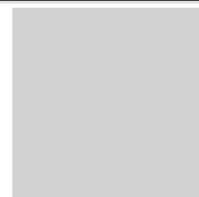
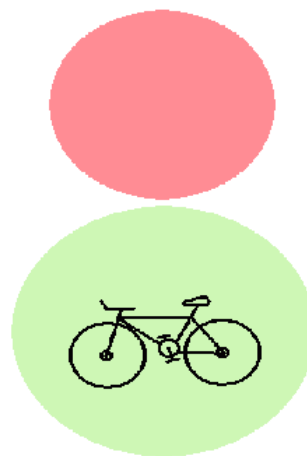
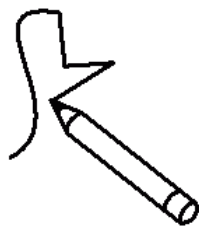
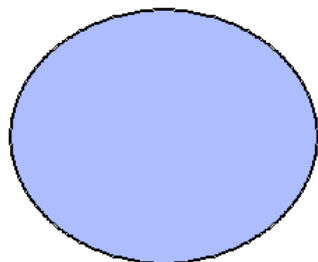
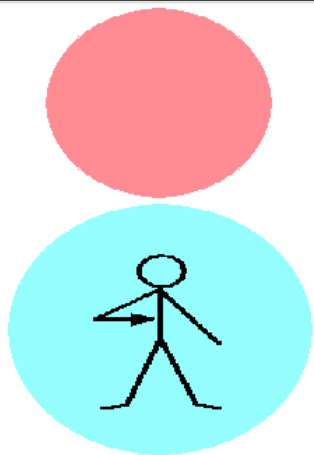
**I draw.**



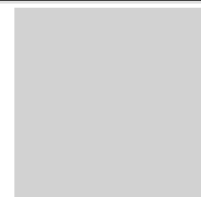
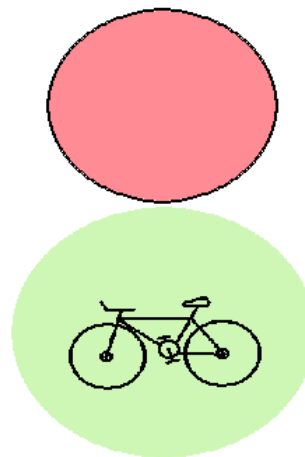
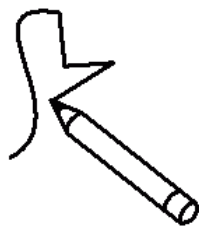
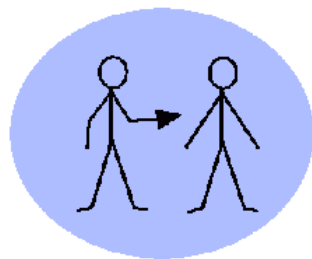
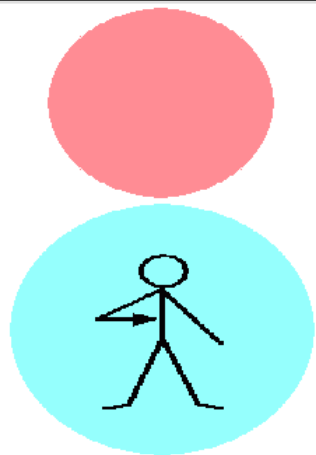
**I draw.**



**I draw a bicycle.**

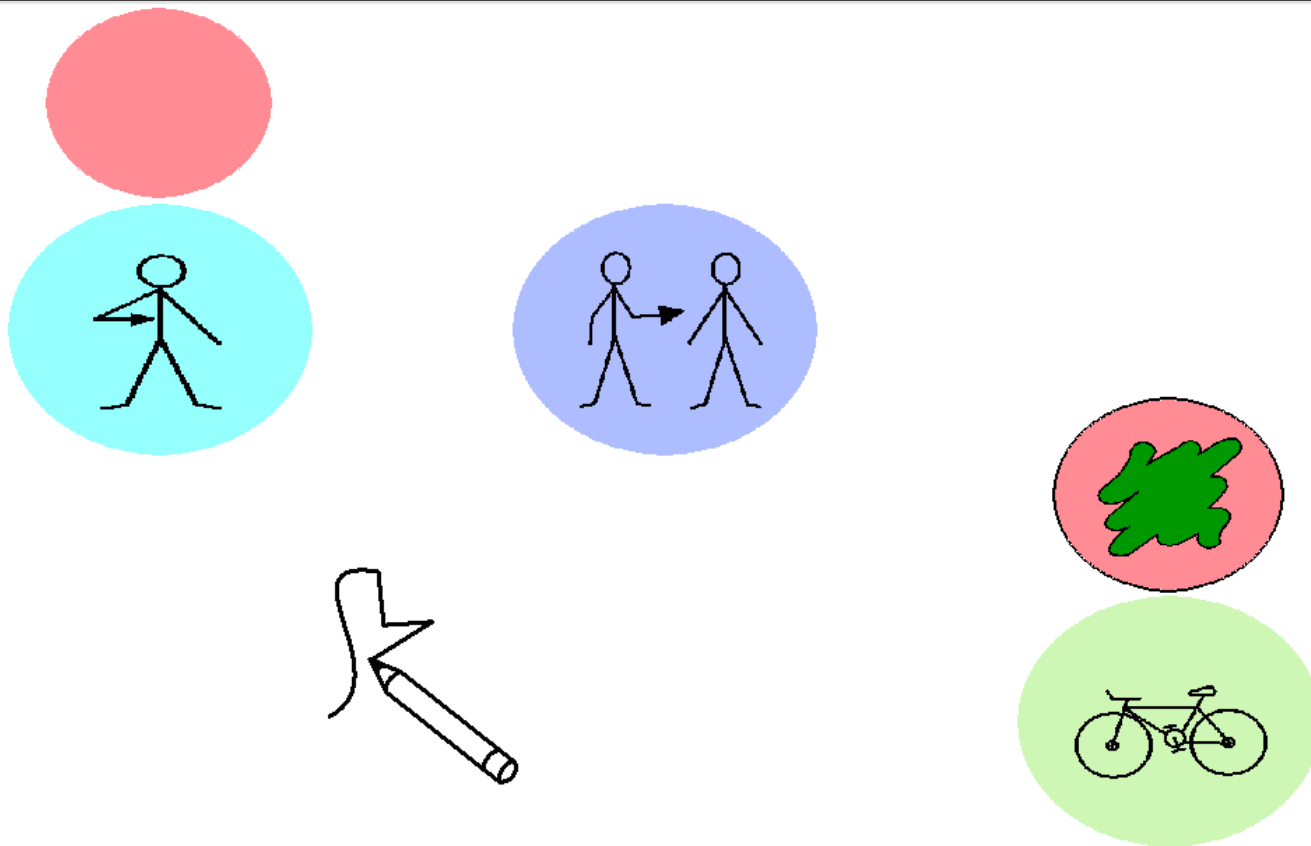


**I draw a bicycle.**

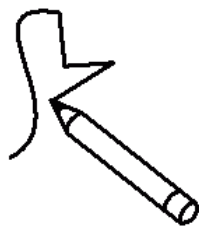
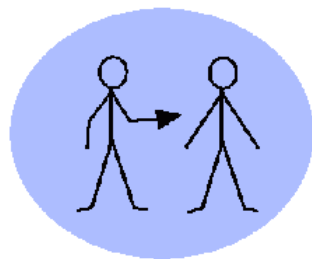
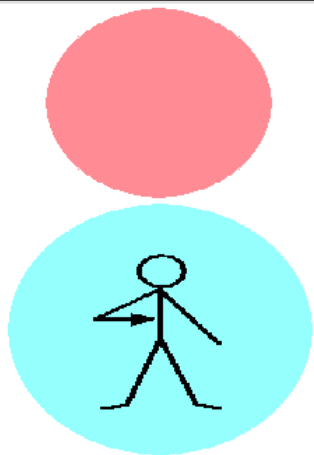


**I draw a bicycle with you.**

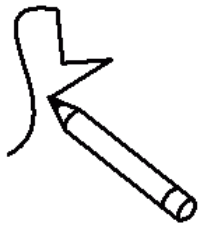
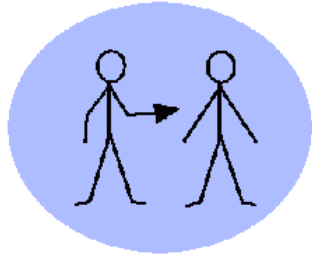




**I draw a green bicycle with you.**



**I draw a green bicycle with you.**



**I draw a green bicycle with you.**

# Characteristics

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- De-emphasized textual representation
  - Semantic frames can be populated in any order
  - Configurable switch modality
  - Configurable ordering patterns
  - Configurable frame complexity
-

A young boy plays with his many small blocks with his friend.

# Observations

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- Required screen space is now tied to message complexity.
  - Full vocabulary is hidden/filtered.
  - Prediction/ordering controls speed of construction.
  - Some classifications are tricky -- where should illocutionary acts (e.g. small-talk) go?
-

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# Part 4: **Evaluation**

# User Group #1: "ND"

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- Non-disabled (ND), to provide a theoretical upper bound on performance
  - 24 English-speaking adults
  - 10 males and 14 females
  - Ages 19 - 43 (mean of 24)
-



## User Group #2: "SMI"

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- Speech and motor impairments (SMI)
- Ages 33 - 56 (mean of 41)

ID	Sex	Motor	Speech	Mode
P1	F	Mild	Mild	Unaided
P2	M	Mild	Moderate	Unaided
P3	F	Moderate / Severe	Mild	Unaided and Switch
P4	M	Severe	Severe	Caregiver

# Constrained Message Elicitation

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- More open-ended than "copy phrase"
  - More comparable than real-world usage
  - Closed vocabulary controlled via single-action picture cards
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# Example Picture Cards

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# Study Setup

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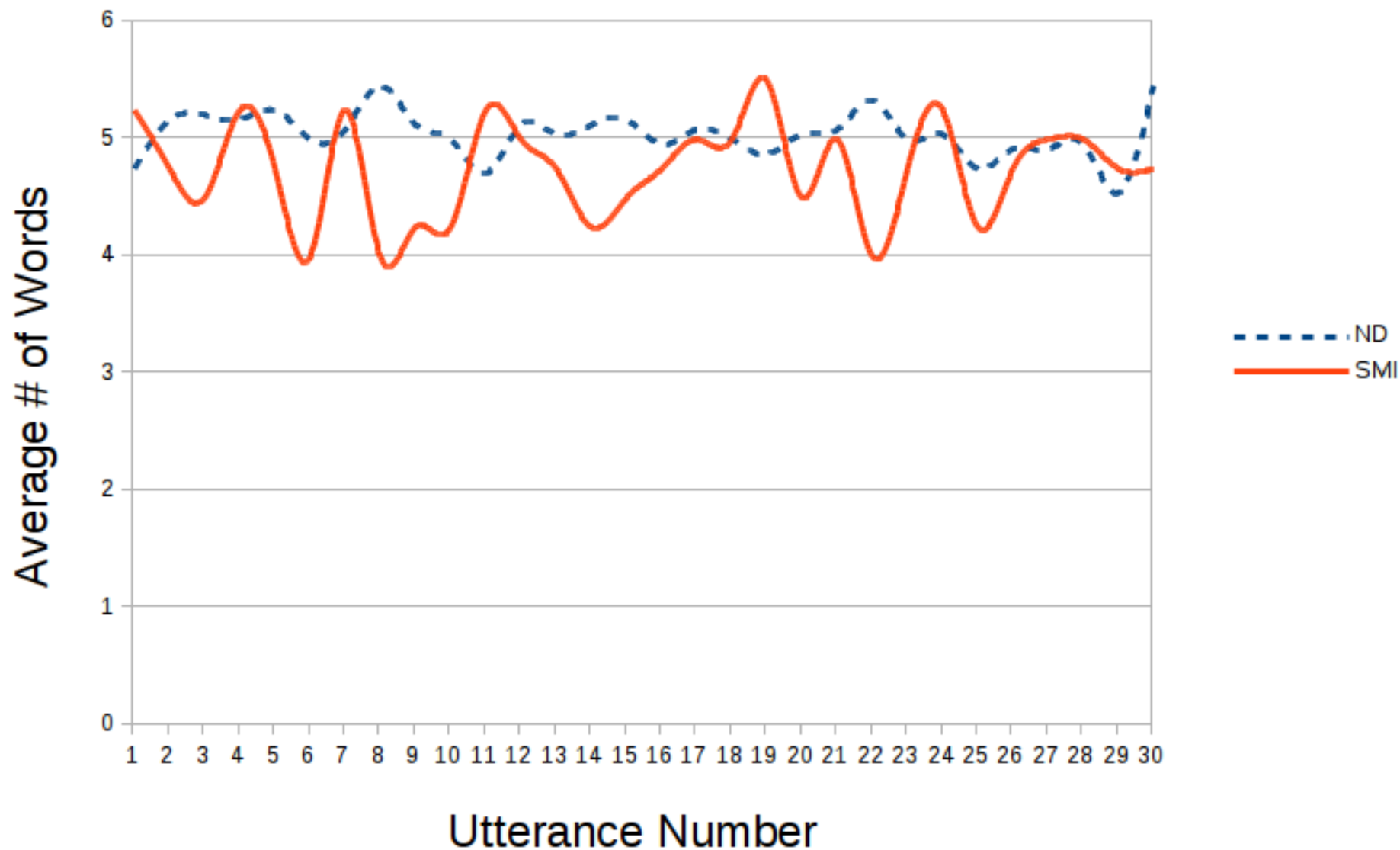
- 30 shuffled cards per person
  - Space bar as switch
  - Starting RSVP speed of 700ms
    - Adjustable by +/- 100ms
  - 106 words tagged in up to 8 roles
  - Unlimited time and alphabetic ordering
-

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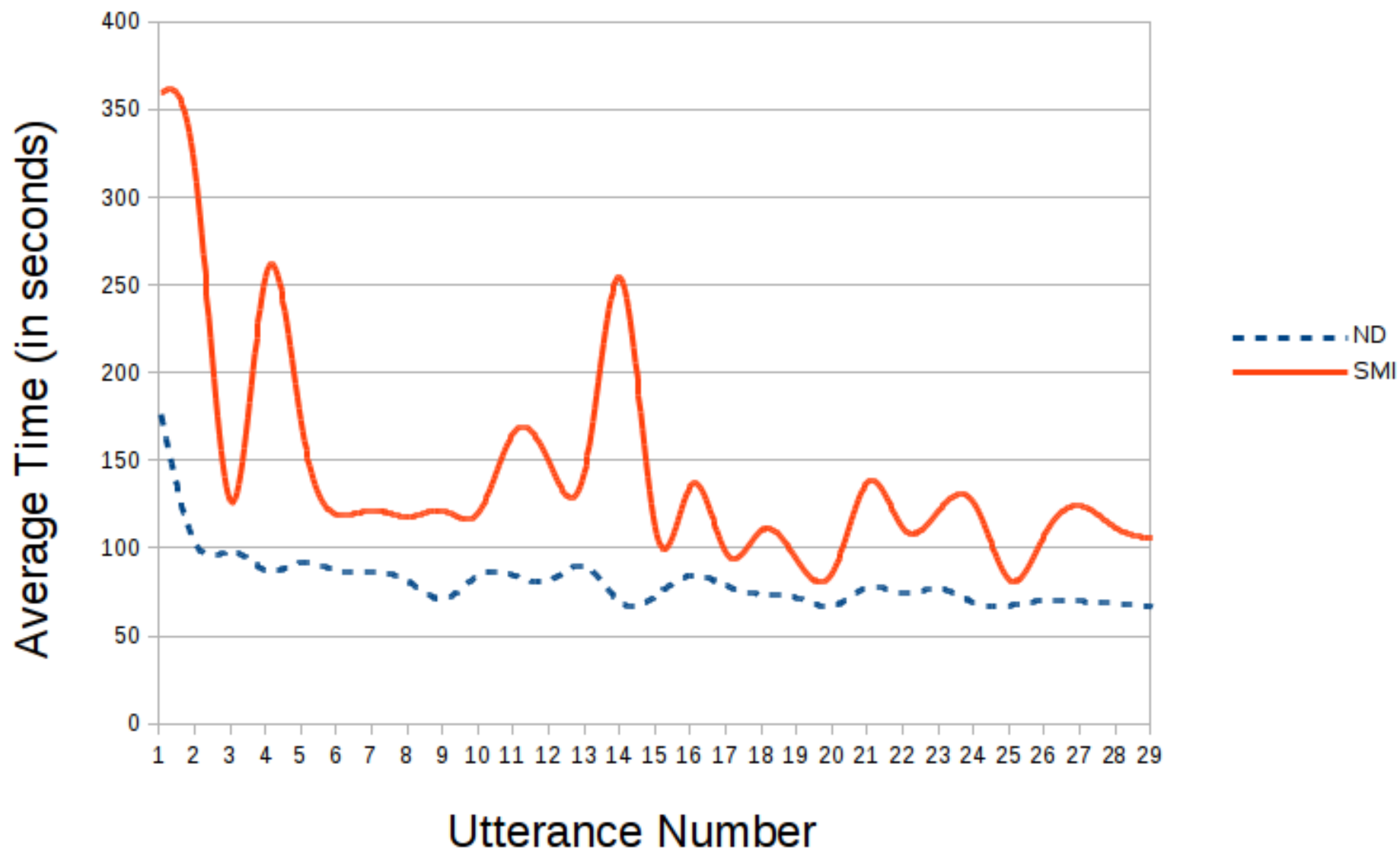
# Part 5: **Results**

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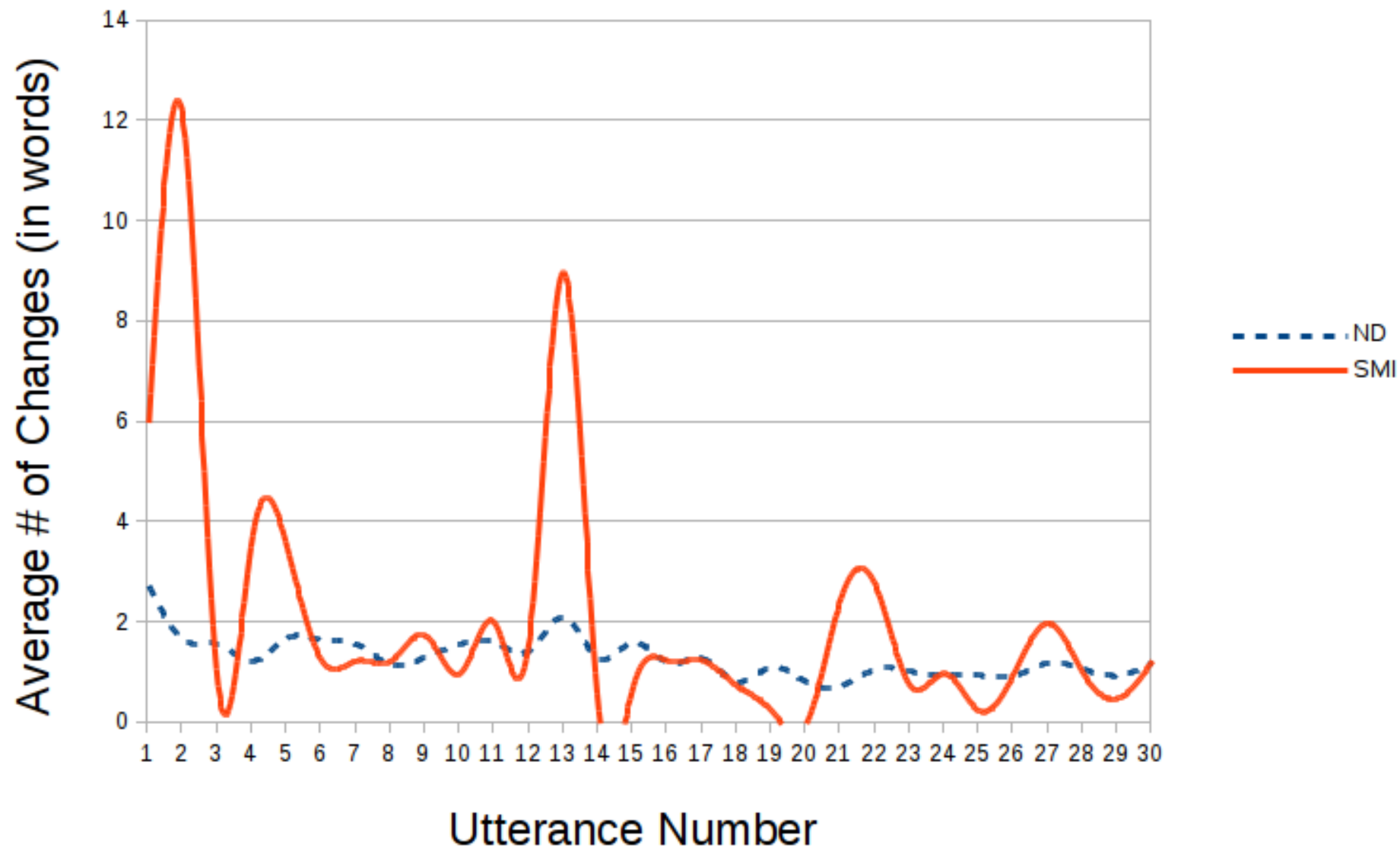
# Utterance Complexity



# Construction Time

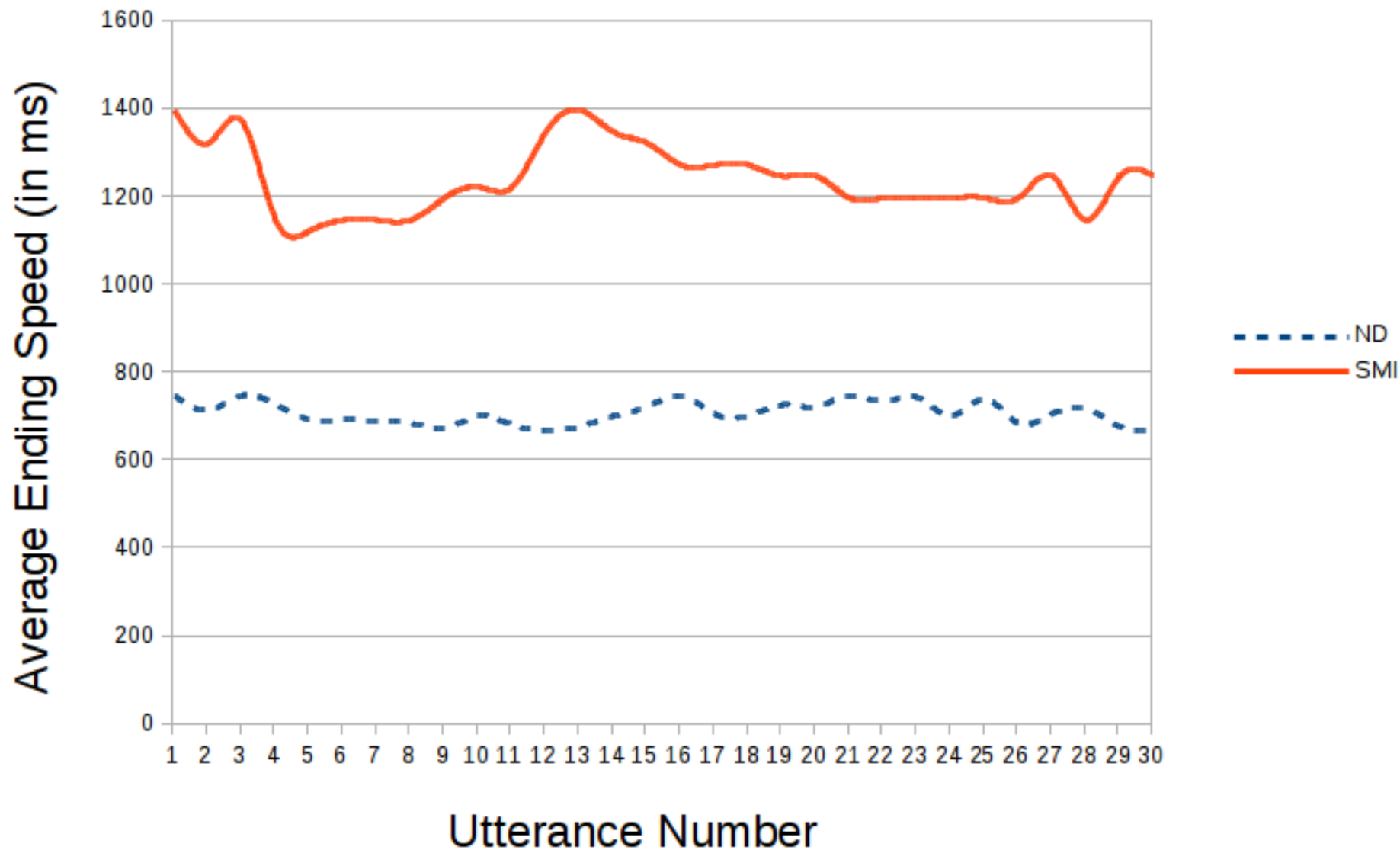


# Errors and Modifications

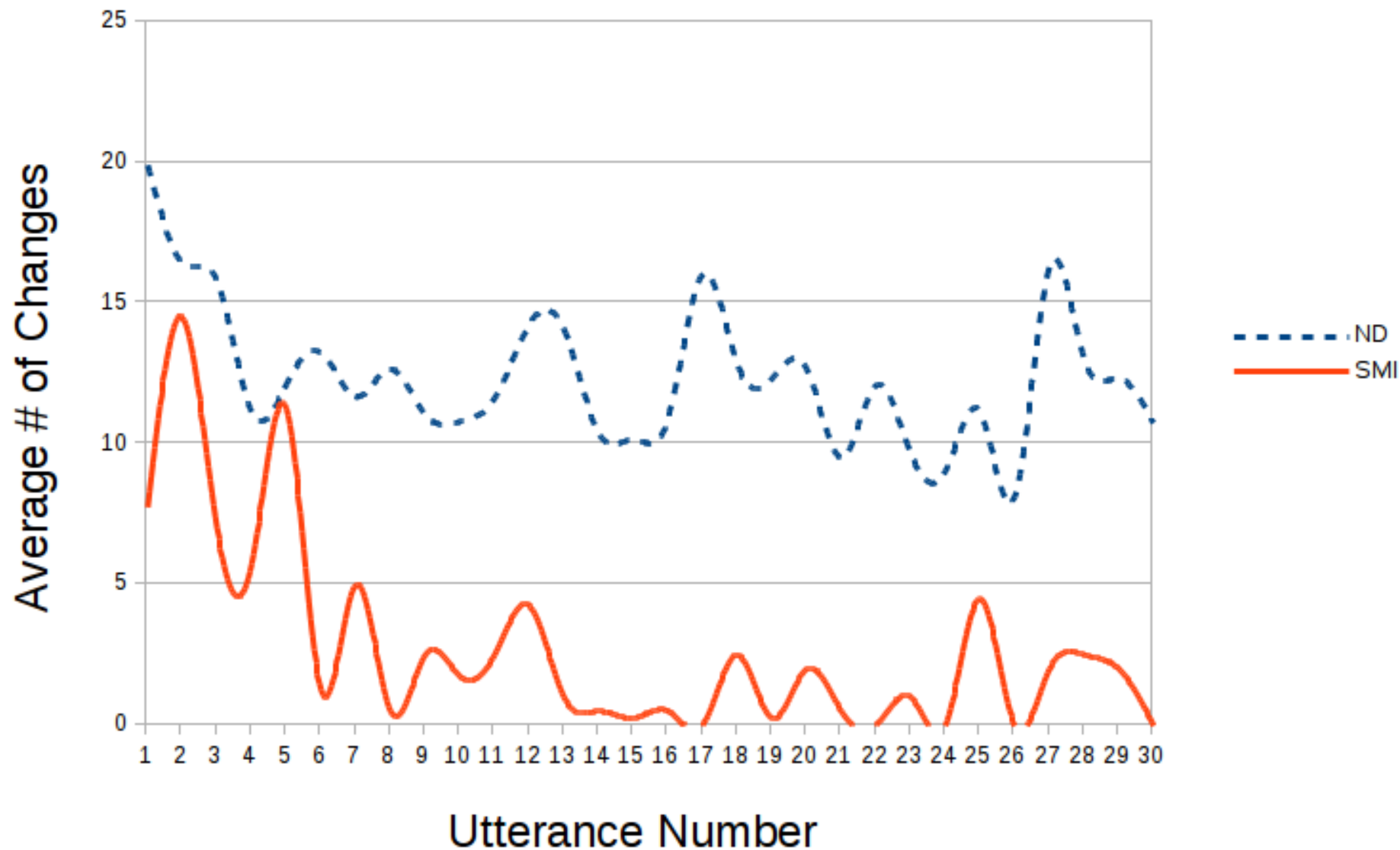




# RSVP Speed



# RSVP Speed Changes



# Quantitative Summary

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- No nonsensical utterances
    - Average of 5 selections (verb + 4)
  - Average speed of last 5 utterances:
    - 70s (ND) vs. 107s (SMI)
  - RSVP speeds w/ positive motor response:
    - 700ms (ND) vs. 1200ms (SMI)
  - Similar learning curves for both groups
    - Mid-experiment errors may have been exploration
-

# Qualitative Feedback

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- All users get restless w/ alphabetic ordering
  - Even alphabetic ordering can be surprising
  - Numerous users asked about other switching methods and multi-modal adaptations
  - Numerous users favorably mentioned the automatic syntax modification/correction
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Epilogue:

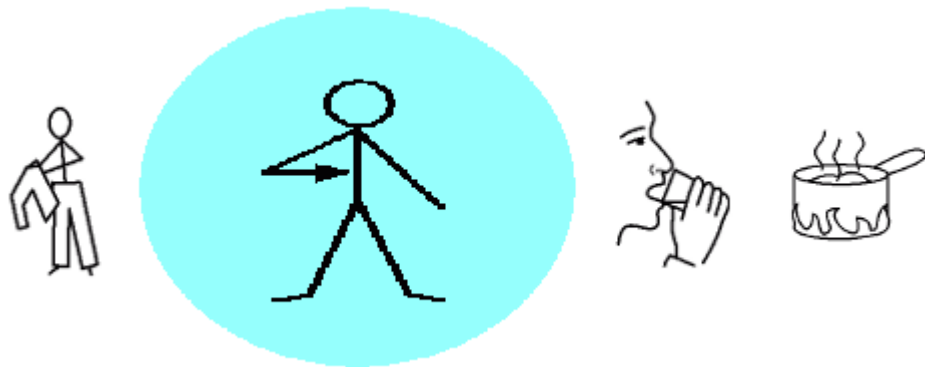
# Closing Thoughts

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# Potential Improvements

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- Slow down near more likely words
- Filter unlikely words based on frames
- Skip to more likely alphabetic positions
- Carousel:



# Current Applications

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- Small-screen and mobile systems
    - Perhaps combined with a hand-held controller
  - Multi-modal or analog input combinations:
    - Push the switch harder to go faster
    - Directional switches
    - "Oops" functionality
  - Involuntary responses: muscle twitch, BCI
    - Can then leverage predictive reordering
    - Initial results expected later this year
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# Thank you for listening!

**[karlwiegand.com/csun2014](http://karlwiegand.com/csun2014)**



Thanks to Dr. Rupal Patel, Dr. Deniz Erdogmus, and the National Science Foundation (Grant #0914808).

