Semantic Disambiguation of Non-Syntactic and Continuous Motion Text Entry for Icon-Based AAC

Karl Wiegand
Northeastern University
Boston, MA USA
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Outline

1. Background on AAC
2. Problem Statement and Thesis
3. Projects and Goals
4. Theories and Approaches
5. Implementation and Experiments

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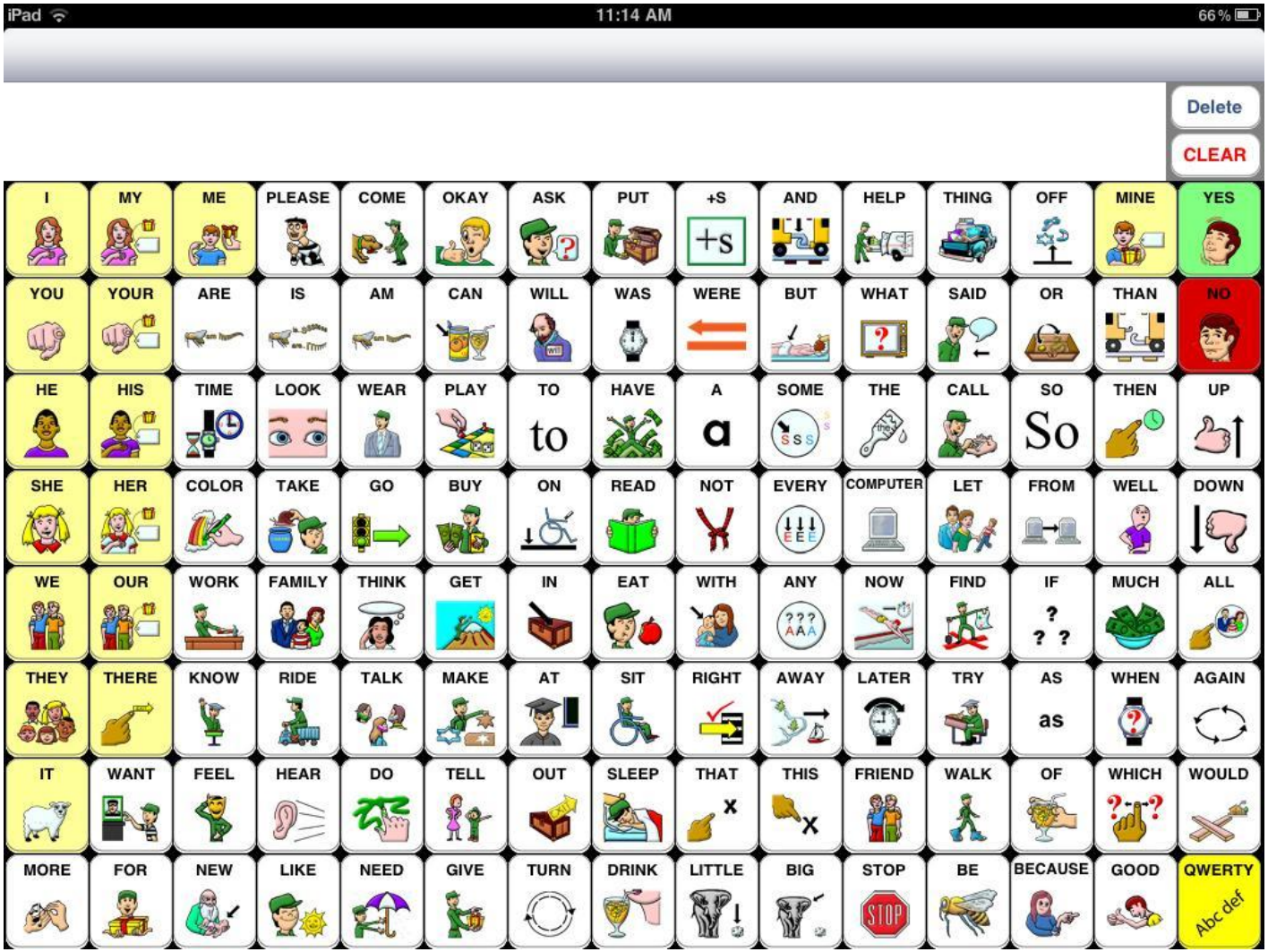
What is AAC?

- Augmentative and Alternative Communication
- Three major categories:
  - Assisted communication
  - Physical boards with letters, words, or images
  - Electronic devices with integrated Text-to-Speech (TTS) systems

Who uses AAC?

- People of all ages
- People with:
  - cerebral palsy (CP)
  - amyotrophic lateral sclerosis (ALS)
  - brain and spinal cord injuries
  - neurological disorders (e.g. aphasia)
  - muscular dystrophy
  - paralysis, autism, and more...

Current AAC System



Scope and Definitions

- Target users are primarily non-speaking and may have upper limb motor impairments
- Target users may also have language impairments (e.g. aphasia)
- "Icon-based AAC" includes systems that use words, icons, or a combination of both
- "Non-syntactic" is non-standard syntax or inconsistent syntax

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Problem Statement

Current icon-based AAC systems assume:

1. Syntactic Order
2. Intended Set
3. Discrete Entry

Assumption 1: Syntactic Order

- Users will select icons in the syntactically correct order of the target language.
- Without syntactic order, how do we handle directional utterances? (near vs. like)
- Users do not always select icons in syntactic order (Van Balkom and Donker-Gimbrere, 1996)
- Using AAC devices is slow (Todman, 2000; Wolpaw et al, 2002; Muller and Blankertz, 2006)

Assumption 2: Intended Set

- Users will select exactly the icons that are desired -- no fewer or more.
- Without this, how do we complete subsets (predict) or prune supersets (correct)?
- Motor impairments and tremors may result in missing or additional selections (Ball, 2005)
- Letter-based text entry systems detect accidental and deleted selections

Assumption 3: Discrete Entry

- Users will make discrete movements or selections, either physically or with a cursor.
- Selection is important; path is irrelevant
- Recent letter-based systems have started to remove this assumption (Goldberg, 1997; Kushler and Marsden, 2008; Rashid and Smith, 2008)
- Removing this assumption enables the use of continuous input signals

Thesis Statement

These three assumptions are problematic and burdensome to users.

Algorithms and design approaches can mitigate the need for these design constraints.

Alleviating these constraints can:

- Result in faster, less fatiguing communication
- Enable the use of new input modalities

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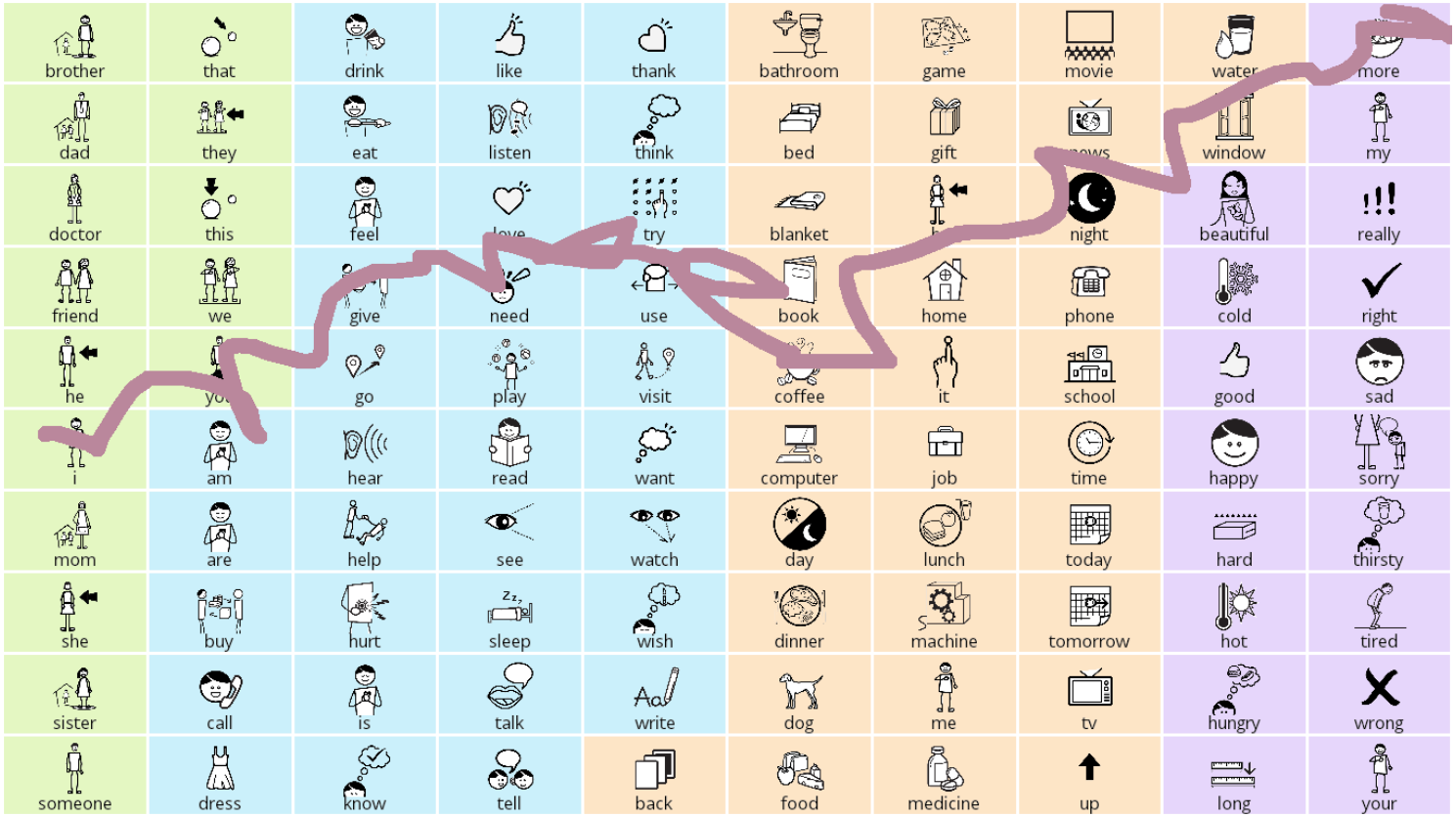
Project: SymbolPath

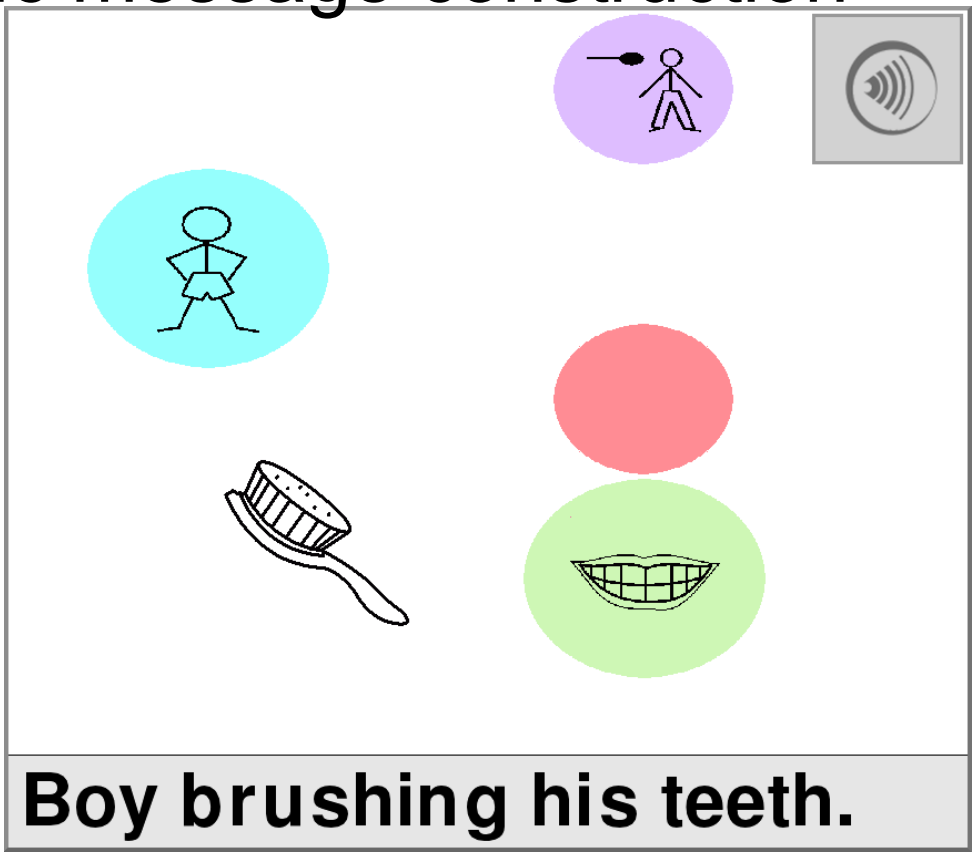
- Relaxation of all three major assumptions



"I need more coffee."

Project: RSVP-iconCHAT

- Continuous input signal (BCI) and non-syntactic message construction



Goals

For current AAC:

- Completion and correction
- Continuous motion

For future AAC:

- Faster communication
- New input modalities
  - Vowel sounds
  - Electromyographic responses (EMG)
  - Brain-computer interfaces (BCI)

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Addressing Syntactic Order

- Semantic frames (Fillmore, 1976)
- Verbs have a "frame" with semantic roles:

Give (*Agent*, *Object*, *Beneficiary*)

- WordNet, FrameNet, "Read the Web"
- Verb-first message construction (Patel et al, 2004)
- Any order in RSVP-iconCHAT

Addressing Intended Set

- Subset completion and superset pruning
  - N-grams; Compansion (McCoy et al, 1998)

- Semantic grams (Wiegand and Patel, 2012)

"I like to play chess with my brother."

brother, chess	brother, i	brother, like
brother, play	chess, i	...

brother, chess, i	brother, chess, like
brother, chess, play	chess, i, like
chess, i, play	...

Addressing Discrete Entry

- Physical path or signal characteristics
  - Letter-based continuous motion (Goldberg, 1997; Kushler, 2008)
  - Relative positioning vs. exact locations (Rashid, 2008)
- Merge semantic salience with path attributes
- SymbolPath considers:
  - Starting and ending locations
  - Movement speed
  - Pauses, stops, or sudden changes in direction
  - Jitter and tremor

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Proposed Corpus Experiments

Semantic roles:

- Sem-grams vs. WordNet & FrameNet vs. tuples (left words, verb, right words)

Contextual cues:

- Location, time of day, discourse markers

Syntactic reordering:

- FrameNet vs. N-gram-based permutations

Proposed User Experiments

RSVP-iconCHAT:

1. Create a sentence
2. Describe a picture scene
3. Clinical trial with regular feedback

SymbolPath:

1. Type vs. draw
2. Respond to a prompt
3. App Store release and feedback

Thank you for listening!

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