PPA

- slowly progressive aphasia caused by neurodegenerative disease; a frontotemporal dementia
- no focal lesion (e.g., stroke)
- most prominent clinical feature is difficulty with speech/language
- speech/language deficits are the principal cause of impaired activities of daily living; (eventually affects cognitive, behavioral and functional domains)
- often affects individuals <65 years

(Mesulam, 2008; Gorno-Tempini et al., 2011)
1. Location of atrophy

2. Underlying pathology

3. Stage of disease

Degeneration of brain structures that result in different PPA variants (Wilson et al., 2012).
<table>
<thead>
<tr>
<th>Speech &amp; Language Characteristics</th>
<th>Logopenic Variant (PPA-L)</th>
<th>Nonfluent/Agrammatic Variant (PPA-G)</th>
<th>Semantic Variant (PPA-S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>*palpable word finding difficulties, pauses, circumlocutions in conversational speech</td>
<td>*motor speech impairment, slow and effortful speech; sound errors: distortions, substitutions, deletions, insertions of speech sounds (consistent with apraxia of speech)</td>
<td>*gradual decline in semantic/object knowledge: anomia, deterioration of single-word comprehension; *hyper verbal and fluent speech with word-finding difficulties and semantic paraphasias</td>
<td></td>
</tr>
<tr>
<td>*grammatically simple sentences</td>
<td>*altered prosody</td>
<td></td>
<td>*dyslexia/dysgraphia</td>
</tr>
<tr>
<td>*impaired repetition of sentences and phrases; phonologic errors in speech.</td>
<td>*difficulty understanding complex sentence structure</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cognitive Characteristics</th>
<th>Logopenic Variant (PPA-L)</th>
<th>Nonfluent/Agrammatic Variant (PPA-G)</th>
<th>Semantic Variant (PPA-S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>*poor verbal memory, <strong>working memory</strong> and cognitive switching; *impairments in executive functions, visuospatial tasks *impairments in processing numbers</td>
<td>*disproportionate difficulty with executive functions—specifically verbal fluency, set-shifting and abstract thinking.</td>
<td></td>
<td>*difficulties with episodic memory and executive function</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Probable Pathology</th>
<th>Logopenic Variant (PPA-L)</th>
<th>Nonfluent/Agrammatic Variant (PPA-G)</th>
<th>Semantic Variant (PPA-S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alzheimer’s Disease</td>
<td>Tau (Fronto-Temporal)</td>
<td></td>
<td>TDP-34 (Fronto-Temporal)</td>
</tr>
</tbody>
</table>
Treatment themes in PPA

**Timing**
- Start early & be proactive so person with PPA can learn to use communication strategies and tools as soon as possible

**Partner Training**
- Training from the beginning and throughout

**Degeneration**
- Adjust treatment strategies over time **and** use multiple modalities to capitalize on patients’ strengths

(Fried-Oken, M., Mooney, A., & Peters, B., 2015)
e.g., naming ability, articulation

AAC delivered here

e.g., conversation

e.g., social support, work situation, personal coping style
NIDCD award #1 R21 DC041099-01

- Development of a mobile technology social networking app to support language co-construction and word finding skills.

- Combines AAC technology and innovative Natural Language Processing (NLP) techniques to develop and evaluate a novel intervention tool for individuals with language loss secondary to PPA.
Hypothesis

Using dynamic mobile technology support, people with PPA will increase use of target words during conversation.
<table>
<thead>
<tr>
<th>Gender</th>
<th>Age</th>
<th>S/P</th>
<th>PPA Type</th>
<th>Edu.</th>
<th>Profession</th>
<th>Residence &amp; Conversation Partner</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>73</td>
<td>2.5 years</td>
<td>PPA-A Agrammatic</td>
<td>15 yrs</td>
<td>Nurse</td>
<td>Home husband</td>
</tr>
<tr>
<td>Female</td>
<td>80</td>
<td>1 year</td>
<td>PPA-A Agrammatic</td>
<td>15 yrs</td>
<td>Comptroller</td>
<td>Home friend</td>
</tr>
<tr>
<td>Male</td>
<td>62</td>
<td>4 months</td>
<td>PPA-S Semantic</td>
<td>16 yrs</td>
<td>Physical Therapist</td>
<td>Home wife</td>
</tr>
<tr>
<td>Male</td>
<td>72</td>
<td>6 months</td>
<td>PPA-L Logopenic</td>
<td>20 yrs</td>
<td>Engineer</td>
<td>Home partner</td>
</tr>
<tr>
<td>Female</td>
<td>63</td>
<td>1 year</td>
<td>PPA-S Semantic</td>
<td>16 yrs</td>
<td>Accountant</td>
<td>Home husband</td>
</tr>
<tr>
<td>Male</td>
<td>58</td>
<td>6 months</td>
<td>PPA-A Agrammatic</td>
<td>16 yrs</td>
<td>Sheriff</td>
<td>Home wife</td>
</tr>
</tbody>
</table>
Methods: Materials

GOAL: OPTIMIZED AAC for Life Participation

- Natural Language Processing
- Social Networking
- Mobile Technology with JIT
Co-Chat™: Generates a display using NLP techniques, based on:

- Photographs taken by user
- Comments from user’s “social network”

Auto-curated list of target words:
- Nestucca River
- Aimee
- Beaver Oregon
- Clearing
- Backyard
- Next
- Trees
- Said
- Design
- Go
- Trees
Mobile Tech + Just In Time (JIT):

**HISTORICAL PROBLEM IN AAC**
- Time consuming to program current Visual Scene Displays (VSDs) with vocabulary
- Partners do not add or update frequently
- Difficult to dynamically capture new experiences and add them to AAC technologies or apps
- Lose spontaneity

**POSSIBLE SOLUTIONS: JIT**
- JIT allows quick and easy import of photos as VSDs
- Allows partners to dynamically respond to interests
- Partners add communicative contexts to support conversation ‘on the fly’ during daily interactions

Drager, Light et al., 2014
Visual Scene Displays:

**CAN BE USED TO:**
- Stimulate and support conversation: *shared context with communication partner*
- Facilitate *active participation* in spontaneous activities
- Shift focus from expression of wants/needs to *social interaction* and exchange of ideas

**FOR PEOPLE WITH APHASIA:**
- Personally relevant
- High context photographs
- Text boxes

(Beukelman, Hux, Dietz et al., 2015)
Natural Language Processing:
Computer processing of human language to analyze, modify, augment or generate words for machine applications.

Part of speech tagging: proper nouns

Term frequency weighting

Contextually relevant

List of Suggested Target Words
Contextually Relevant: Similar but diverse!

DOG: SIMILAR, BUT NOT VERY DIVERSE
- doggie
- puppy
- canine
- hound

DOG: SIMILAR YET DIVERSE
- bark
- leash
- pet
Social Network Comments:

**Good**
- Your Dad and Mike taking a boat ride on the lake
- They are celebrating Mike’s birthday
- Mike loves driving the boat
- Dad and Mike enjoy boating together
- A perfect Michigan summer day on Lake St. Clair

**Bad**
- What lake are you on?
- You guys are rocking it!
- Great day
- Fun!
- Is it sunny?
Social networking: Social media use in seniors (65+)

- 56% use Facebook (up from 45% 1 year prior)
- 16% use Pinterest
- 12% use LinkedIn
- 8% use online discussion forums
- 4-6% use Twitter & Instagram

Methods: dependent variable

- Number of target words used per conversation
- 10 Target words produced from “Social Network” comments + innovative NLP
Methods: Experimental Design

- Single Subject Research
- Alternating Treatments Design (ATD)
- Compare effect of Co-Chat™, photo-only and no technology on the number of target words
- Use the What Works Clearinghouse (WWC) design standards for visual analysis

ATD (Wolery, Gast & Ledford, 2014); WWC (2014)
Methods: Procedures

- Consent
- Assess language, cognition
- Train Co-Chat™ to mastery
- Complete Conversation Partner training
Methods: Procedures

- Conduct activity when conversation partner NOT present, photograph activity and send to “social network” for comment

- NLP analyzes comments and generates lexical display with original photo

- Participant engages in conversations over 3 conditions
Three conversation conditions

1. No tech
2. Photo only
3. Co-Chat™
Results: Target Words generated

- Data evaluated using visual analysis, focusing on
  - overlap between conditions
  - changes in level
  - variability
  - trend within and across intervention conditions

- RESULTS INDICATE A HIGHER NUMBER of TARGET WORD PRODUCTION in Co-Chat™ condition for all participants.
Results: Target words

**001 AH Target Words / Conversation**

**002 EB Target Words / Conversation**

**004DW Target Words / Conversation**

**005WH Target Words / Conversation**
100% non-overlapping data between Co-Chat™ and other two conditions.

<table>
<thead>
<tr>
<th>Condition</th>
<th>TW Range</th>
<th>TW Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Technology</td>
<td>0-7</td>
<td>3.5</td>
</tr>
<tr>
<td>Photo-only</td>
<td>1-6</td>
<td>3.0</td>
</tr>
<tr>
<td>Co-Chat™</td>
<td>6-10</td>
<td>7.5</td>
</tr>
</tbody>
</table>
005WH: Making Risotto

Social Network Comments:

- “I would love to eat risotto with shrimp and shiitake for dinner.”
- “Risotto on a rainy night is a perfect dinner.”
- “A dinner alone at home with shrimp and shiitake mushrooms sounds yummy.”
- “Have a bottle of wine with your shrimp risotto on this cold night.”
- “This is a delicious dinner for a rainy fall night.”
- “Tonight is perfect night to eat at home.”
- “You are a wonderful chef for your family.”
Cohort 2: Counterbalanced

**004DW.2 Target Words / Conversation**

- Co-Chat App Target Words
- NT: Blue line and markers
- PO: Red line and markers
- APP: Green line and markers

**006CP Target Words / Conversation**

- Co-Chat App Target Words
- NT: Blue line and markers
- PO: Red line and markers
- APP: Green line and markers

Sessions:
- V1 to V6
“Which conversation was the easiest?” $n = 36$
PARTICIPANT WITH PPA

- “More informational.”
- “I really like this.”
- “It helps, especially with the right words.”
- “I like the words {on the app}; if nothing else it refreshes my memory on the names and words.”
- “I think the words around the picture really help.”
- “The words really help to direct and focus my storytelling.”
- “When I don’t have enough time to talk it helps.”

CONVERSATION PARTNER

- “He talked more than ever!”
- “He talked longer and started to add more detail.”
User Experience Questionnaire (UEQ)

Measure the User Experience of your product fast, easy and flexible

N = 36

<table>
<thead>
<tr>
<th></th>
<th>Range</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>learnability</td>
<td>0 to 3</td>
<td>2.67</td>
</tr>
<tr>
<td>support</td>
<td>-1 to 2</td>
<td>2.61</td>
</tr>
</tbody>
</table>
Discussion:

- We conducted a rigorous single subject experimental design study including 6 people with PPA.
- Trends indicate that the intervention increases production of Target Words; showing a STRONG experimental effect.
- Users find conversations to be easier when using this technology.
- Users find the intervention both easy to learn and supportive during unstructured conversation.
Our data indicate that the use of Mobile Technology (incorporating Just In Time photo capturing, innovative Natural Language Processing and Visual Scene Display) paired with Social Networking is useful as an AAC compensatory strategy to support language loss in PPA.
We humbly thank all of our research participants and their conversation partners.