TEXAS
The University of Texas at Austin

Aphasia and AAC: Factors Influencing Use of Speech Output Technologies: Theoretical and Practical Implications

Rajinder Koul, PhD, CCC-SLP

Houston Harte Centennial Professor and Chairperson

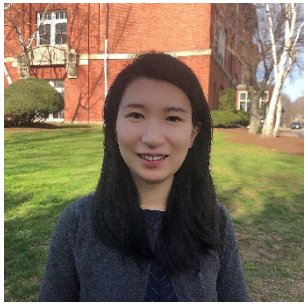
Department of Speech, Language and Hearing Sciences

The University of Texas at Austin | Moody College of Communication

Ackowledgements

Tiffany Chavers
UT at Austin

Kristofer Brock
Idaho State U



Cissy Cheng
UT at Austin

Katie Rayer
UT at Austin

Ralf Schlosser
Northeastern U

Melinda Corwin
Texas Tech U

AAC Lab at UT Austin
https://slhs.utexas.edu/research/augmentative-and-alternative-communication-lab

Advances in AAC Technology for Adults with Aphasia: Primary Themes

- Cognitive processing and AAC
- Allocation of cognitive resources in relation to use of speech output technologies
- AAC Interface displays
- Efficacy of speech output technologies in AAC intervention
- Social validation framework

Advances in AAC Technology for Adults with Aphasia: Primary Themes

- **Cognitive processing and AAC**
- Allocation of cognitive resources in relation to use of Speech-generating technologies
- AAC Interface displays
- Efficacy of speech output technologies in AAC intervention
- Social validation framework

Recent History of AAC Aphasiology

- Technology-based AAC interventions have become increasingly available for people with aphasia (PWA). These interventions include dedicated speech generating devices (SGDs) and/or mobile technology applications that produce speech output upon selection of a message. (Rayer, Chavers, Schlosser, & Koul, 2022)
- Exploration of the impact of various interface features have on cognitive processing and communication behaviors is becoming increasingly important b/c of the advent of mobile technology and "communication apps." (Gutmann & Koul, 2023; Koul, Dietz, Corwin, & Wallace, 2012)

Mobile Technology & Communication Apps

- People with communication disorders, including PWA, download these apps and seek assistance from SLPs to integrate these tools into their repertoire (AAC-RERC, 2011).
- Thus, evidence regarding the impact of AAC interface features on the cognitive processing and communicative and linguistic performance of PWA is needed to guide clinical decision-making.

Aphasia Candidates for AAC

Chronic severe Broca's aphasia

Global aphasia

AAC Interface Displays

Taxonomic displays

Visual scene displays

AAC and Aphasiology: The Merger

Early on:

- AAC interventions focused on applying categorically organized interfaces originally designed for people with motor impairments.
- Over time and with instruction, PWA learned how to use categorically-organized, icon-based AAC interface designs during structured interactions (Brock, Koul, Corwin, & Schlosser, 2017; Koul, 2011; Koul, Corwin, & Hayes, 2005).

Taxonomic Grid Display

(Brock & Koul et al., 2017)

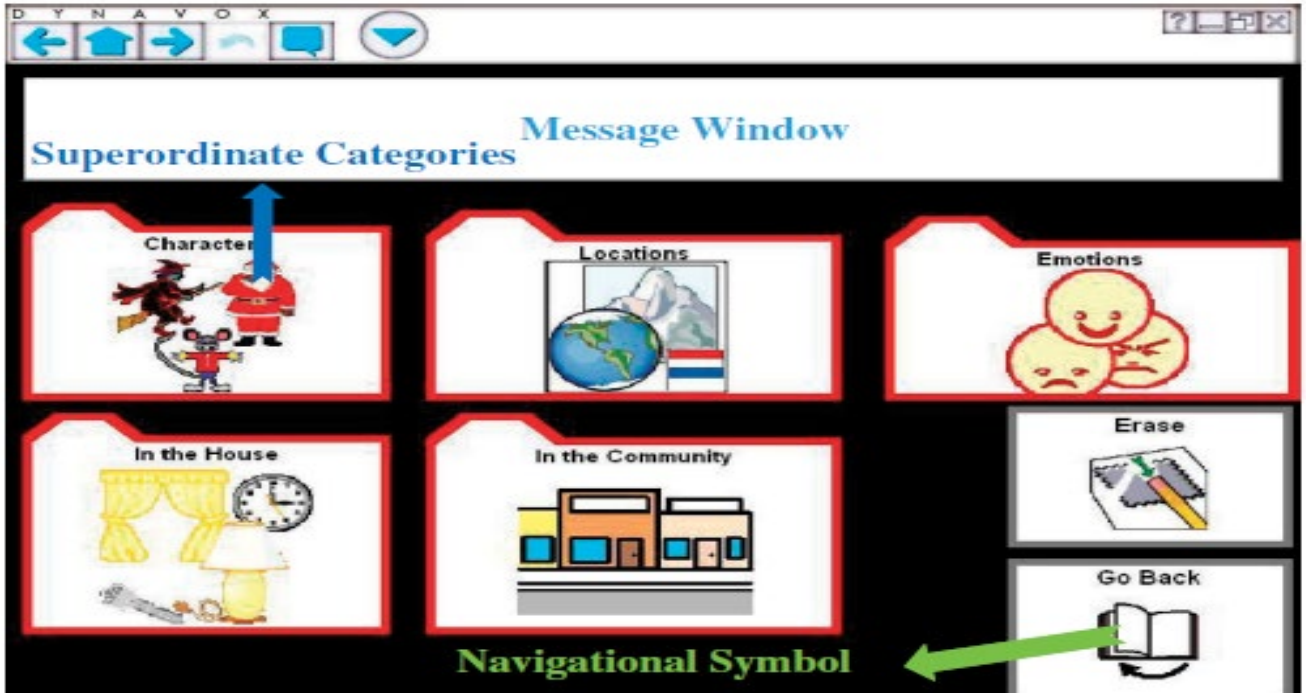
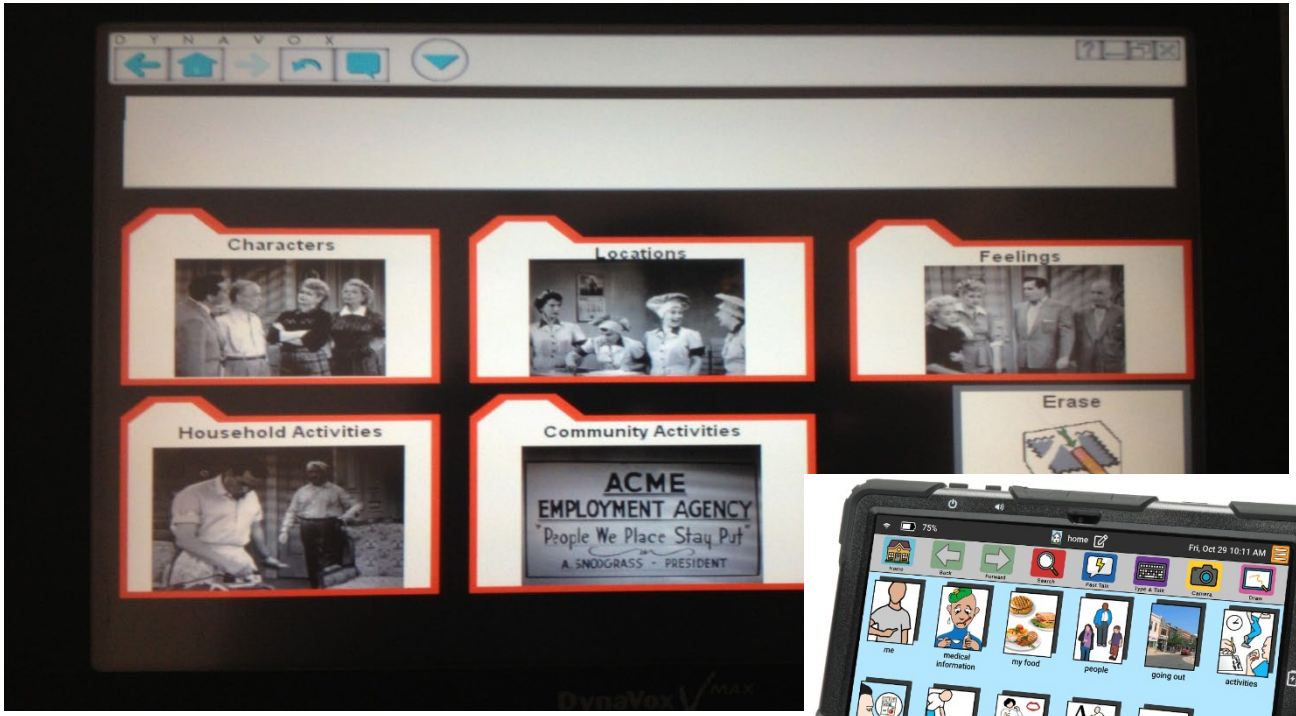


Figure 1. Grid display.
Note: The home screen for one of the grid displays depicting the five superordinate categories and navigational symbol. The folders were highlighted red, indicating that another page will open upon activation. (©2016 Tobii Dynavox. All rights reserved)

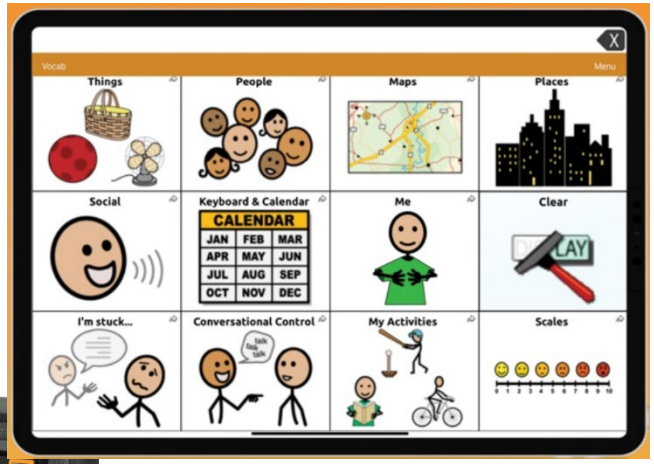
Taxonomic Grid Display

(Brock & Koul et al., 2017)



Taxonomic Grid Display

(Brock & Koul et al., 2017)



AAC & Aphasiology

- Categorical and iconic organization requires considerable visual--cognitive and linguistic processing (e.g., Brock, Koul, Corwin, Schlosser, 2022).
- Taxes the impaired working memory of PWA (McNeil, 1983; McNeil, Odell, &Tseng, 1991).
- Therefore, a shift in approach:
  - Design AAC interfaces that compliment the residual cognitive and linguistic abilities of PWA
    - Visuospatial perception
    - Episodic Memory
    - Navigation
    - Personalized messages

    (e.g., Petroi & Koul, 2014; Brock, Koul, et Dietz, Beukelman, & McKelvey, 2006; McKelvey, Dietz, Hux, Weissling, & Beukelman, 2007)

Visual Scene Display

(Brock & Koul et al., 2017)

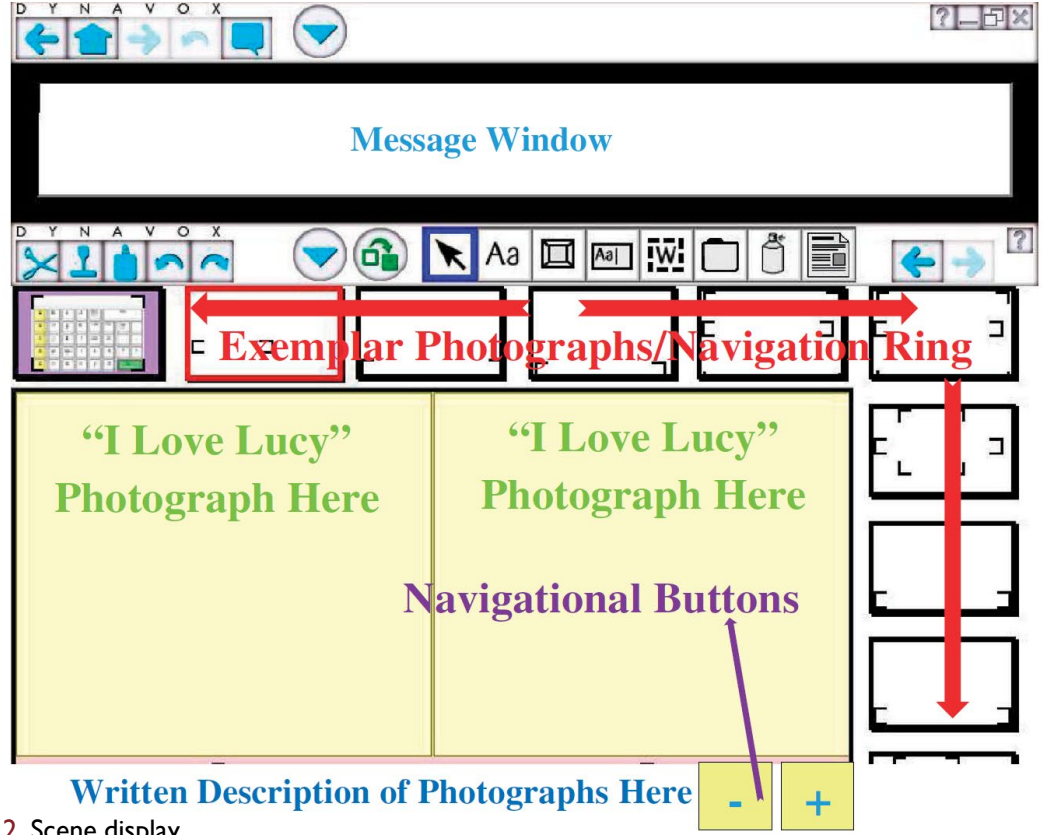
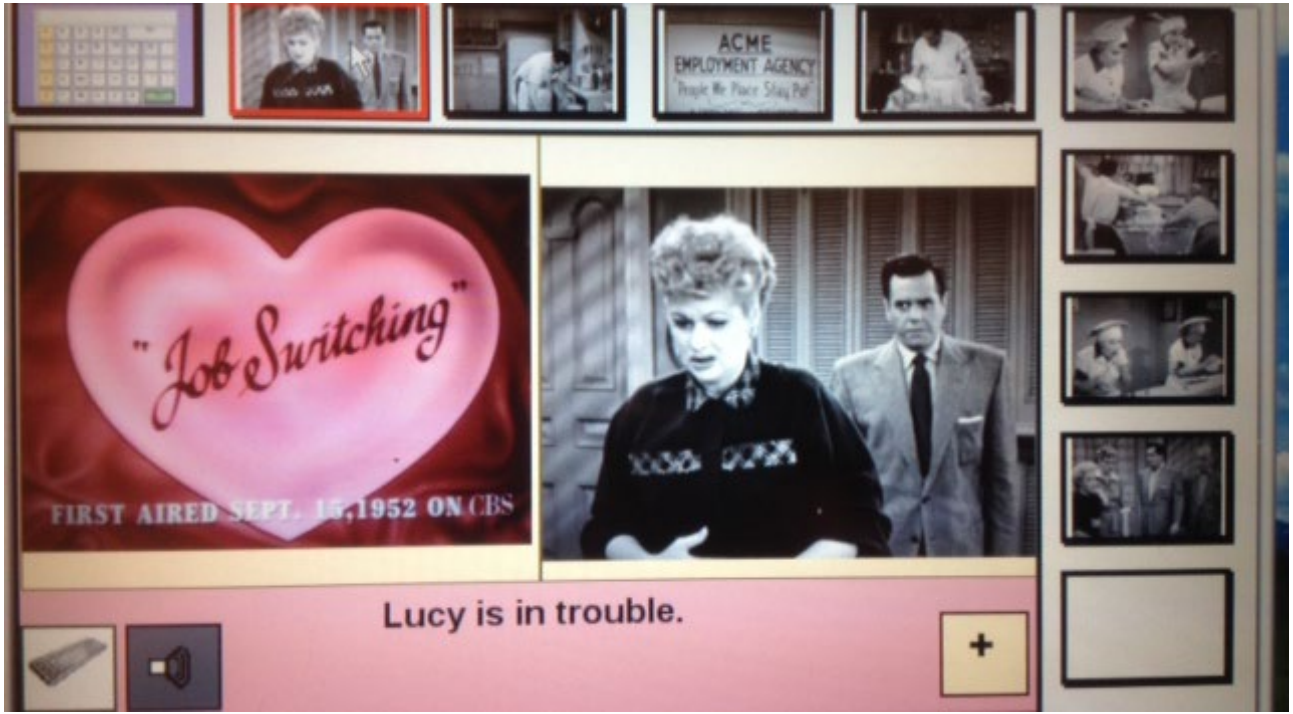


Figure 2. Scene display.

Note: The scene display template used for each experiment depicting the exemplar photographs, navigational symbols, and a one-sentence description of each photograph. (©2016 Tobii Dynavox. All rights reserved)

Visual Scene Display

(Brock & Koul et al., 2017)



Visual Scene Display

(Brock & Koul et al., 2022)

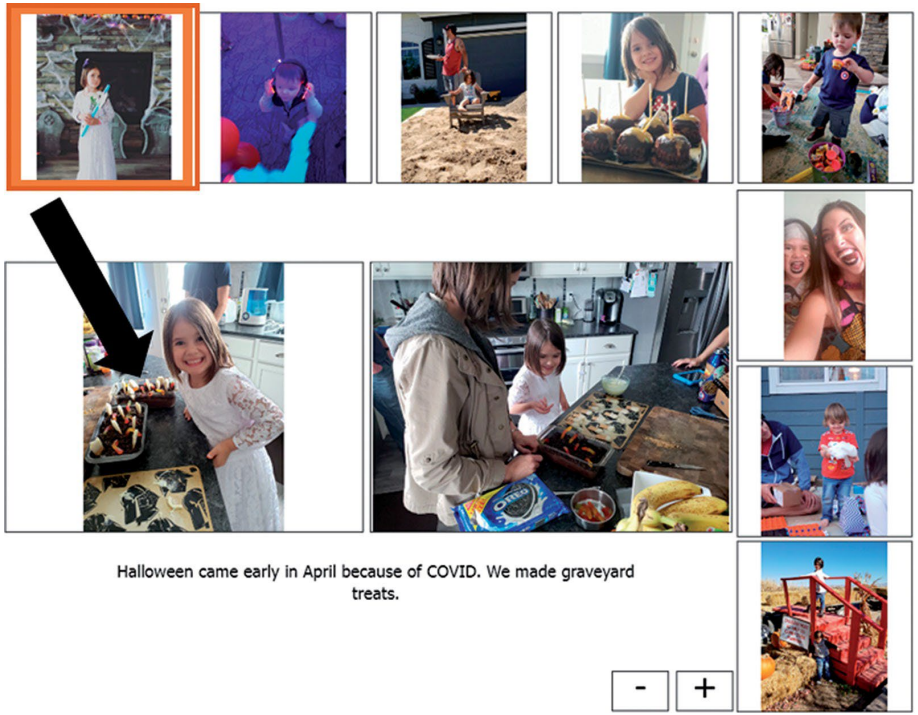


Figure 2. Scene display layout example. *Note.* The orange border indicates that the first exemplar photograph was activated. Next, two photographs related to the exemplar photograph are on display in the center of the scene display. An additional eight photographs can be accessed, two at a time, by selecting the "þ" button.

Visual Scene Display

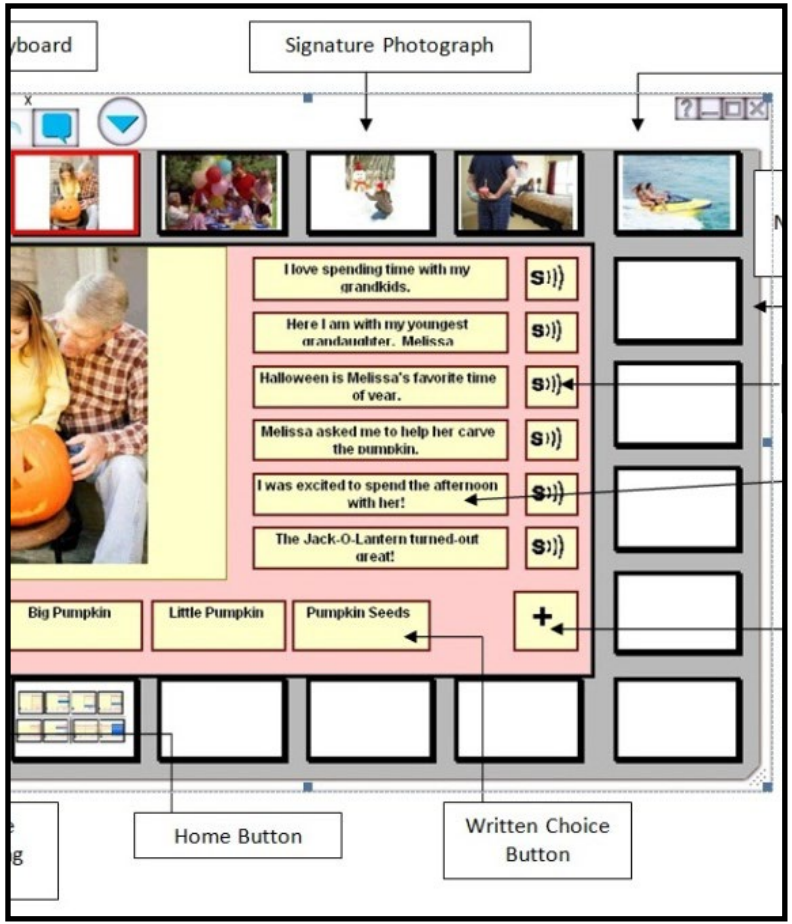
AAC & Aphasiology

Visual Scene Displays (VSDs) build upon:

- Reduced navigation
- Episodic memory
- Contextual cues

Reducing cognitive load

(Brock, Koul, et al., 2022)



David Beukelman, 2008 ©

Advances in AAC Technology for Adults with Aphasia: Primary Themes

- Cognitive processing and AAC
- **Allocation of cognitive resources in relation to use of speech output technologies**
- AAC Interface displays
- Efficacy of speech output technologies in AAC intervention
- Social validation framework

Cognitive Processing

- Multi-stage phenomena
- **Stages:** perceptual identification → response selection → response initiation and execution
- Rate and Efficiency with which information is processed
- Involves the allocation of multiple mental resources

(Broadbent, 1958; Kahneman, 1973; Navon & Miller, 2002; Pashler & Johnston, 1989, Kahneman,1973)

Cognitive Processing

- Complementary systems
  - Attention
  - Working memory
  - Executive function
- A breakdown in any of these systems adversely affects the efficiency and rate at which information is transferred during interactions.

(e.g., Baddeley, 1986; Baddeley, 2000; Broadbent, 1958; Daneman & Carpenter, 1980; Just & Carpenter, 1992; Kahneman, 1973)

Cognitive Processing in PWA (1)

Resource Allocation Theory of Aphasia

- deficits in attention can affect or contribute to the symptoms associated with aphasia
- both attentional and language factors contribute to symptoms observed in persons with aphasia
- reduced capacity/inefficient allocation as task complexity increases

(McNeil et al., 1991; Murray, 1999, 2002)

Cognitive Processing in PWA(2)

Attentional impairments negatively affect completion of language tasks and perception of task difficulty

(Arvedson & McNeil, 1986; Clark & Robin, 1995; Erickson et al., 1996; Murray, 2000; Murray et al., 1997a, 1997b, 1997c, 1998; Tseng et al., 1993)

- Decreased accuracy & longer RTs in focused/divided attention conditions
- Demands exceed available capacity and resources are allocated inefficiently

(McNeil et al., 1991; Murray, 1999, 2002)

Cognitive Processing in PWA(3)

Aphasia is also associated with reduced working memory capacity

(Caspari et al., 1998; Miyake, Carpenter, & Just, 1994; Murray, 1999)

- Intact semantic processing abilities vs. phonological deficits
- Working memory is mediated through language and language impairment effects the performance of PWA on working memory tasks.
  - Working memory may also contribute to or occur in addition to impaired language processing

Cognitive Processing in PWA(4)

Aphasia is also associated with executive functioning deficits

- Executive function skill may dictate AAC usage more than the severity of the aphasia
- Executive function deficits may manifest as impaired cognitive flexibility
  - PWA do not switch modalities when there is a breakdown without prompting
    - When prompted often select an appropriate (trained) strategy.
    - Must instruct PWA to switch
      - (avoid teaching strategies in isolation)

(Purdy, Duffy, & Coelho, 1994; Purdy & Koch, 2006; Purdy & Dietz, 2010)

Cognitive Processing in PWA: Summary

PWA exhibit

- limited capacity or attention
- allocation of attentional resources in natural language (i.e., comprehension and production)

(e.g., Arvedson & McNeil, 1986; Erickson, Goldinger, & LaPointe, 1996; Murray, 2000; Murray, Holland, & Beeson, 1998)

- reduced cognitive flexibility

(Frankel et al., 2007; Holland, Frattali, & Fromm, 1999; Nicholas, Sinotte, & Helm-Estabrook, 2005; Purdy , Duffy, & Coelho, 1994)

Cognitive Processing in PWA: Summary

- Sufficient evidence of relationship between executive functioning and communicative competence (Connor, & Albert, 2000; Ramsberger, 2005)
- However, **very little data are available** on how cognitive processing deficits affect the use of AAC methods/strategies in PWA.

Cognitive Processing: Use of AAC Systems (1)

Processing demands during typical communicative interactions

- attend to the environment
- attend and recall relevant information
- identify an expressive modality
- retrieve the spoken/gestural/graphic representation of the word and combine the representations to form syntactically and semantically correct sentences
- comprehend pragmatic and linguistic information
- employ metacommunication skills

(Garrett & Kimelman, 2000)

Cognitive Processing: Use of AAC Systems (2)

Processing demands are increased during communicative interactions when AAC strategies and techniques are employed

- Cognitive processing skills important for use of AAC strategies: perceptual processing, executive function, attention, memory, & resource allocation/capacity
- Deficits in these domains may interfere with the ability of PWA to effectively & efficiently use SGDs

(Caplan & Hanna, 1998; Duffy & Coelho, 2001; Frankel et all, 2007; Garrett & Kimelman, 2000; Koul & Harding, 1998; Nicholas, Sinotte, & Helm-Estabrook, 2005; Purdy, 1992; Purdy & Dietz, 2010; Purdy & VanDyke, 2009; Weinrich et al., 1997)

Cognitive Processing: Use of AAC Systems (3)

Light's (1989) Communication Competence

- Operational Competence
  - Ease of learning: interface design
    - Grids vs. VSDs
  - Instruction
- Strategic Competence
    - Recognition of a 'breakdown'
    - Generate possible solutions to the problem

Cognitive Processing: Use of AAC Systems (4)

- Execute a solution
  - i.e., 'switching' to different mode of communication
  - Cognitive flexibility

(Frankel et al., 2007; Light, 1989; Purdy, 1992; Purdy & Dietz, 2010; Purdy & VanDyke, 2011)

- Social Competence
  - Interactional use of the AAC strategies
  - Requires strong interpersonal skills
  - Metacommunication skills

Cognitive Processing: Use of AAC Systems (5)

- Linguistic Competence
  - Auditory comprehension difficulties
  - Reading comprehension difficulties
  - Word retrieval difficulties
  - Syntactic difficulties

(Garrett & Kimelman, 2000)

Resource Allocation and Message Organization

Resource Allocation

Message Organization

Petroi, D., Koul, R., & Corwin, M. (2014).

Resource Allocation and Message Organization

Taxonomic Displays

- Number of semantic organization levels
- Number of messages/symbols per screen
- Competing and Concurrent tasks (information processing load)
- Accuracy of responses
- Latency of responses
  - tied to rate of communication

Deficits in these domains may interfere with the ability of PWA to effectively & efficiently use SGDs

AAC and Aphasia (1)

- Variables:
  - Number of symbols per screen (4, 8, 12, and 16)
  - Semantic levels (levels 1, 2, and 3)
  - Experimental condition (focused, sustained, and divided attention)
- Participants:
  - PWA (n=10)
  - Control (n=10)
- Design: Between-group design
- Analysis: Mixed repeated measures ANOVA

Participant Number	Age/ Gender	Education (y)	Diagnosis/site of lesion	Severity/Type/Time Post Onset (m)	WAB AVC[1]/ AQ[2]
1	62 (M)	18	Status post MVA with skull fracture; left parietal healing surgical wound; SAH, SDH	Moderate/Broca's, 41	9.85/67.30
2	68 (M)	10	Stroke with right hemiparesis	Moderate/Broca's, 87	7.5/2.80
3	60 (M)	14	Left hemispheric ischemia, intracranial ICA occlusion	Severe/Broca's, 59	7.85/26.90
4	50 (M)	15	Acute multifocal ischemic infarcts in left basal ganglia/ periventricular white matter	Severe/Broca's, 40	6.15/26.50
5	47 (M)	8	Hypoattenuation in left > right frontoparietal and temporal lobes suspicious for acute infarcts	Severe/Broca's, 26	7.9/40
6	59 (M)	16	Stroke with subsequent right hemiplegia and hemiparesis	Moderate/Broca's, 117	7.8/63.20
7	46 (M)	11	Large left MCA infarct	Moderate/Broca's, 101	6.4/9.80
8	68 (F)	18	Subacute massive left MCA territory infarct	Moderate/Broca's, 123	9.65/63.90
9	54 (F)	12	Acute ischemic infarction in left MCA distribution	Moderate/Broca's, 77	9.15/67.50
10	52 (F)	14	Acute left MCA infarction of temporoparietal lobes	Moderate/Broca's, 88	7.25/56.50
Mean	**57.05**	**13.60**		**32.40**	**7.95/52.44**
SD	7.99	3.33		24.80	1.26/15.79

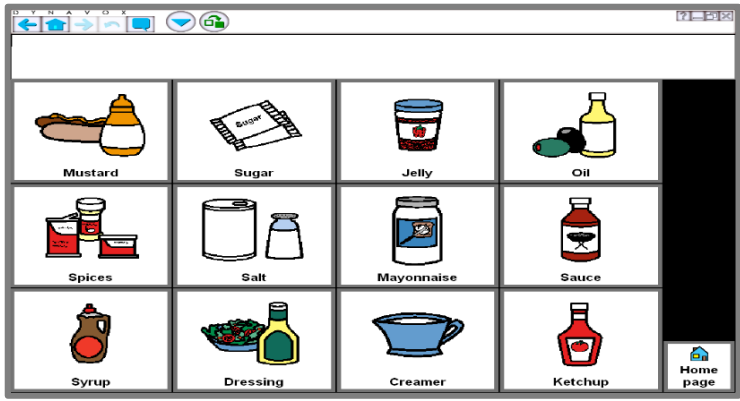
(Petroi, D., Koul, R., Corwin, M., 2014)

AAC and Aphasia (2)

(Petroi, D., Koul, R., Corwin, M., 2014)

- Task 1: Identification of single symbols (e.g., couch, baseball game)
  - Number of symbols per screen (4, 8, 12, and 16)
  - Levels (1, 2, and 3)
- Example of Task 1: 12 symbols - level 1 – navigate through 3 screens to locate target (e.g., **ketchup** (i.e., screen 1: *groceries*, screen 2: *condiments*, screen 3: *ketchup*)

3

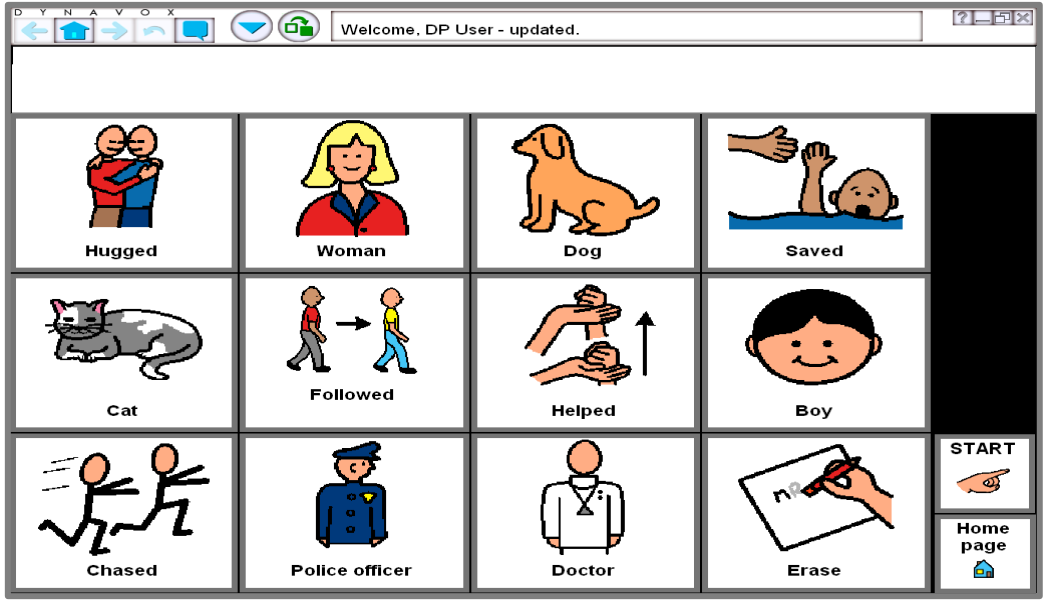


1

2

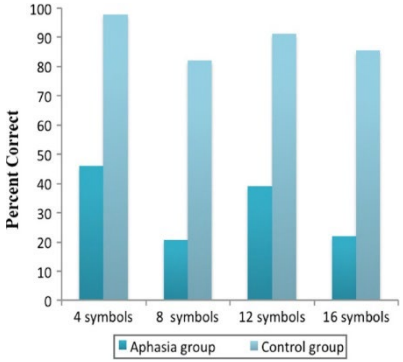
AAC and Aphasia (3)

- Task 2: Identification of multiple symbols representing SVO sentences
- Example sentence for Task 2: **The boy helped the dog.** Target symbols to be selected from this screen are **boy**, **helped**, **dog**

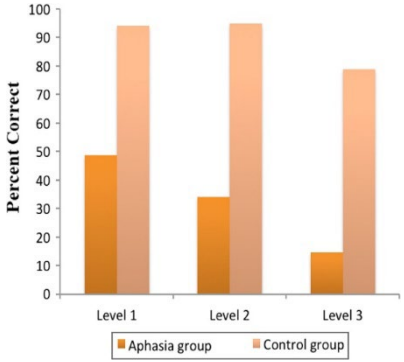


(Petroi, D., Koul, R., Corwin, M., 2014)

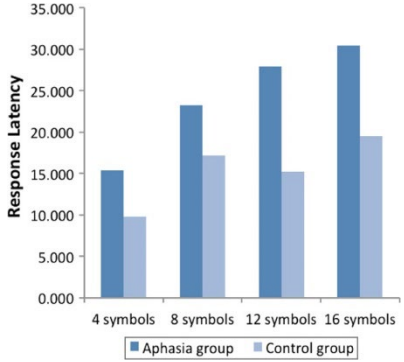
AAC and Aphasia (3)



Single Symbol Identification (Number of Symbols)



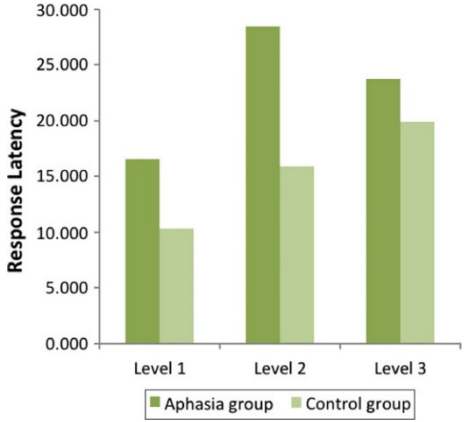
Single Symbol Identification (Navigation Level)



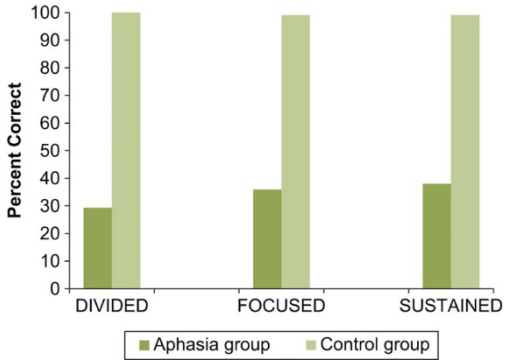
Mean Response Latency (Number of Symbols)

(Petroi, D., Koul, R., Corwin, M., 2014)

AAC and Aphasia (4)



Mean Response Latency (Level)



Mean SVO Sentences (Listening Conditions and Groups)

(Petroi, D., Koul, R., Corwin, M., 2014)

Results

Total items	Set	Target Symbols	Aphasia group (percent correct)	Control group (percent correct)
1	S4-L1	Couch	68.89%	100%
2	S4-L2	Oatmeal	50%	93.33%
3	S4-L3	Blouse	23.33%	100%
4	S8-L1	Chess	20%	80%
5	S8-L2	Dr. appointment	26.67%	96.67%
6	S8-L3	Flying	13.33%	70%
7	S12-L1	Ketchup	71.67%	96.67%
8	S12-L2	Baseball game	30%	96.67%
9	S12-L3	Shampoo	20%	79.26%
10	S16-L1	Shovel	36.67%	96.67%
11	S16-L2	Nurse	30%	90%
12	S16-L3	Movies	0%	66.67%
			Mean = 32.55%	Mean = 88.83%

AAC and Aphasia (5)

Results:

- Single Symbol task: 51% of the variance is accounted for by the group differences and 23% by the combined level of location (14%) and number of symbols (9%) variables
- Navigating across screens to select a symbol is a relatively more challenging task for PWA than the number of symbol variables
- Taxonomic displays vs. Visual scene displays

Advances in AAC Technology for Adults with Aphasia: Primary Themes

- Cognitive processing and AAC
- Allocation of cognitive resources in relation to use of speech output technologies
- **AAC Interface displays**
- Efficacy of speech output technologies in AAC intervention
- Social validation framework

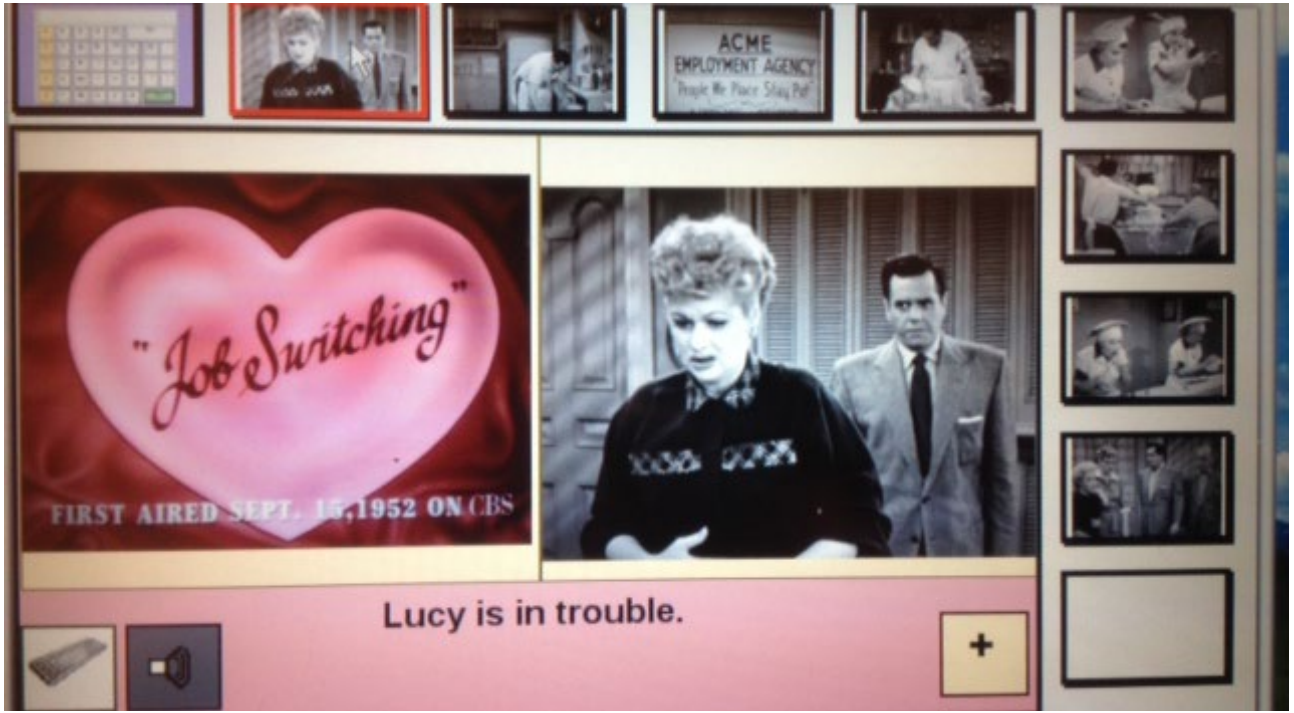
AAC Interface: Scene vs. Grid Displays

Explore the effect of a grid display and a scene display in 2 PWA (Severe Broca's aphasia) across several communication variables during conversational interactions with a partner

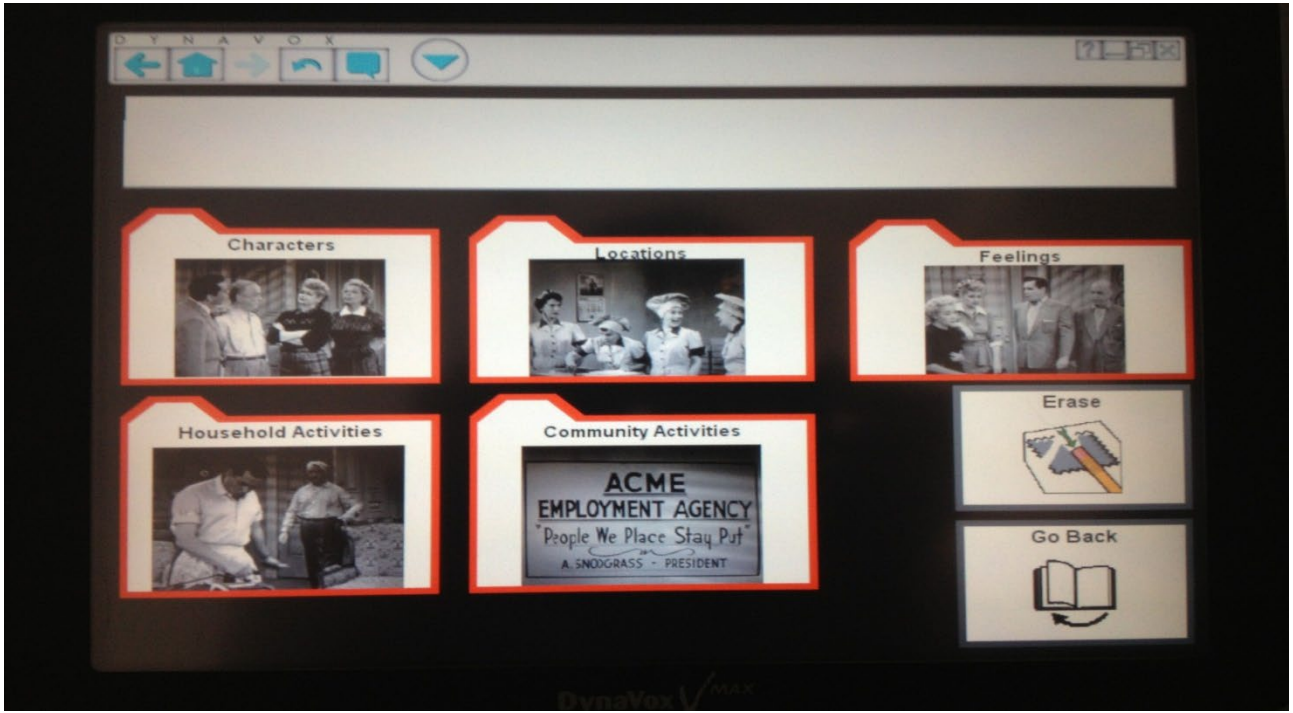
- Case Study design
- Dependent variables: discourse analysis-conversation time, conversation turns, frustration signals, unsuccessful navigation attempts, conceptual complexity, & accuracy of response to probe questions

Brock, K., Koul, R., Corwin, M., & Schlosser, R. (2017)

Visual Scene Display



Taxonomic Grid Display



Methods- Participant # 1

Table 1. detailed flow chart for experiment 1 procedures.

Procedures	Session(s)	Tasks
Pre-experimental procedures	Session 1	(1) *WAB-R* (Kertesz, 2006) (2) Hearing and vision screening (3) Watch "Job Switching"
Scene display training	Sessions 2–4	(1) The participant was trained to identify, locate, and formulate multimodal messages using the photographs.
Scene display conversation	Session 5	(1) Conversation with communication partner
Grid display training	Sessions 6–8	(1) The participant was trained to identify, locate, and formulate multimodal messages using the graphic symbols
Grid display conversation	Session 9	(1) Conversation with communication partner

Methods- Participant #2

Table 2. Detailed flow chart for experiment 2 procedures.

Procedures	Session(s)	Tasks
Pre-experimental procedures	Session 1	(1) *WAB-R* (Kertesz, 2006) (2) Hearing and vision screening (3) Watch "Lucy Changes her Mind"
Phase I: Scene display training	Sessions 2–8	(1) The participant was trained to identify, locate, and formulate multi-modal messages using the photographs.
Phase I: Scene display conversation	Session 9	(1) Watch "Lucy Changes her Mind" Episode (2) Conversation with lead investigator
Phase II: Scene display conversation	Session 10	(1) Watch "Job Switching" episode (2) Conversation with communication partner
Phase I: Grid display training	Sessions 11–18	(1) Watch "Lucy Changes her Mind" episode (2) The participant was trained to identify, locate, and formulate multimodal messages using the graphic symbols
Phase I: Grid display conversation	Session 19	(1) Watch "Lucy Changes her Mind" episode (2) Conversation with lead investigator
Phase II: Grid display conversation	Session 20	(1) Watch "Job Switching" episode (2) Conversation with communication partner

Results

Table 3
Probe Question Response Accuracy for Participants with Aphasia.

Message Organisation	Display	Probe Questions		
		Repeated	Novel	Total %
FB	Scene Display			
	Phase I	N/A	N/A	N/A
	Phase II	2/3 (66.67%)	3/3 (100%)	5/6 (83.33%)
	Grid Display			
	Phase I	N/A	N/A	N/A
	Phase II	1/3 (33.33%)	1/3 (33.33%)	2/6 (33.33%)
SG	Scene Display			
	Phase I	1/3 (33.33%)	2/3 (66.67%)	3/6 (50%)
	Phase II	2/3 (66.67%)	2/3 (66.67%)	4/6 (66.67%)
	Grid Display			
	Phase I	0/3 (0%)	1/3 (33.33%)	1/6 (16.67%)
	Phase II	2/3 (66.67%)	1/3 (33.33%)	3/6 (50%)

Note. The Phase I conversational topic was "Lucy Changes her Mind ." The Phase II conversational topic was "Job Switching. "

Results

Table 4. Frequency of discourse units and utterance complexity levels produced by the participants with aphasia.

		Discourse analysis							Utterance complexity			
	Interface display	Time (minutes)	Conversational turns	Verbal units	Non-verbal units	Verbal + non-verbal units	Frustration signals	Navigation errors	MEL	SAEL	ROEL	REL
FB	Scene display											
	Phase I	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
	Phase II	19.5	251	103	11	137	4	1	162	68	16	5
	Grid display											
	Phase I	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
	Phase II	26	220	100	3	117	11	8	167	48	4	1
SG	Scene display											
	Phase I	26	92	85	1	6	*N/A*	5	85	7	0	0
	Phase II	43	95	77	1	17	*N/A*	9	76	16	0	0
	Grid display											
	Phase I	32	109	88	7	14	*N/A*	11	105	4	0	0
	Phase II	30	69	58	3	8	*N/A*	10	65	4	0	0

The Phase I conversational topic was "Lucy Changes her Mind." The Phase II conversational topic was "Job Switching." *MEL* = Matching Experience Level; *SAEL* = Selective Analysis of Experience Level; *ROEL*; Reordering of Experience Level; *REL*; Reasoning about Experience Level. Frustration signals in Experiment 2 with SG were not recorded secondary to her flat affect.

Communicative Competence and Attitudes: Scene vs. Grid Displays

- Effect of display type (grid display vs. scene display) and respondent group on attitude ratings and perceived communicative competence ratings for a person with chronic severe Broca's aphasia.
- Respondent Groups: Students and caregivers of PWA
- Measures:
  - 8 item Communicative competence Scale (Brock, Koul, et al., 2019)
  - 27 item Attitudes towards nonspeaking persons scale (Gorenflo & Gorenflo, 1991)
- Digital Recordings: Two digital recordings (VSD & TGD) of an English-speaking 61-year-old right-handed male (10 years post-onset stroke) with severe Broca's aphasia and a trained undergraduate communication partner.

(Brock, K., Koul, R., & Schlosser, R., & Corwin, M.,2022)

Communicative Competence and Attitudes: Scene vs. Grid Displays

Scale	Display type	M(SD)	Univariate F statistic
ATNP	Grid	3.59 (.33)	$F(1, 104) = 13.78$, $p > .001$, $\eta_p^2 = .12$
	Scene	3.74 (.34)	
CCS	Grid	3.34 (.64)	$F(1, 104) = 44.68$, $p < .001$, $\eta_p^2 = .31$
	Scene	3.88 (.57)	

Table 4

Scale Means, Standard Deviations, and F Statistics for each Display Condition

Note. ATNP = Attitudes Toward Nonspeaking Persons Scale. CCS = Communicative Competence Scale.

Communicative Competence and Attitudes: Scene vs. Grid Displays

Table 6. Group means, standard deviations, and univariate F statistics for each scale.

Scale	Group	Grid *M*(*SD*)	Scene *M*(*SD*)	Overall *M*(*SD*)
ATNP	Lower division	3.69 (.33)	3.66 (.32)	3.76 (.31)
	Upper division	3.46 (.27)	3.65 (.30)	3.56 (.25)
	Family caregivers	3.74 (.41)	3.81 (.35)	3.77 (.34)
CCS	Lower division	3.27 (.60)	3.85 (.62)	3.48 (.54)
	Upper division	3.29 (.62)	3.84 (.56)	3.49 (.51)
	Family caregivers	3.80 (.70)	4.21 (.40)	3.96 (.52)

Note. ATNP: Attitudes Toward Nonspeaking Persons Scale; CCS: Communicative Competence Scale.

	ANOVA *F* statistic
ATNP	$F\ (2,\ 102) = 6.49,\ p = .002,\ \eta_p^2 = .11$
CCS	$F\ (2,\ 102) = 4.10,\ p = .01,\ \eta_p^2 = .07$

Communicative Competence and Attitudes: Scene vs. Grid Displays

Table 5. Communicative competence factors, items, AAC competencies, and descriptive statistics.

Factors	Item	AAC competency	Interface display	*M*(*SD*)
Successful Communicative Supports	Good communication	Linguistic	Grid	3.27 (.89)
			Scene	4.05 (.75)
	Level of participation	Social	Grid	4.51 (.93)
			Scene	4.88 (.41)
	Computer effects	Operational	Grid	4.06 (1.13)
			Scene	4.70 (.75)
	AAC had effect	Operational	Grid	4.10 (1.05)
			Scene	4.70 (.62)
Conversational Effectiveness	Active partner	Social	Grid	2.40 (1.25)
			Scene	2.67 (1.14)
	Effective communicator	Linguistic	Grid	3.43 (1.13)
			Scene	2.77 (1.30)
	Would engage	Social	Grid	3.14 (1.10)
			Scene	2.79 (1.20)
	Overall effectiveness	Linguistic	Grid	3.64 (1.04)
			Scene	3.43 (1.13)

Communicative Competence and Attitudes: Scene vs. Grid Displays

- Communicative Competence Scale: PWA perceived to be relatively more effective during conversations employing the scene display than the grid display.
- Family caregivers rated the individual with aphasia as having higher communicative competence compared to ratings from upper-division and lower-division undergraduate students.
- Consistent with previous work indicating that individuals with training and experience are more capable of managing health-related matters such as mental illness and aphasia (Radtke, Tate, & Happ, 2012).

Communicative Competence and Attitudes: Scene vs. Grid Displays

- Attitudes Toward Nonspeaking Persons scale- Significant difference between two conditions but small effect size(i.e.,<.25 difference between conditions).
- No conclusions to be yet drawn- AttitudeScale items need to be modified to accurately measure attitudes related to AAC.

Advances in AAC Technology for Adults with Aphasia: Primary Themes

- Cognitive processing and AAC
- Allocation of cognitive resources in relation to use of Speech-generating technologies
- AAC Interface displays
- **Efficacy of speech output technologies in AAC intervention**
- Social validation framework

Current Knowledge: Systematic Review of Efficacy of AAC Intervention in PWA

Meta-analysis of aided AAC intervention in individuals with aphasia

Rayer, K., Chavers, T., Schlosser, R., & Koul, R. (2022). Efficacy of Speech Output Technologies in Interventions for Persons with Aphasia: A Scoping Review. Aphasiology.

Introduction

Purposes

- Map the research evidence on the effectiveness of AAC interventions that involve a speech output technology as part of the treatment package for PWA.
- Summarize research findings and identify gaps in the existing literature.

Methods

Inclusion criteria:

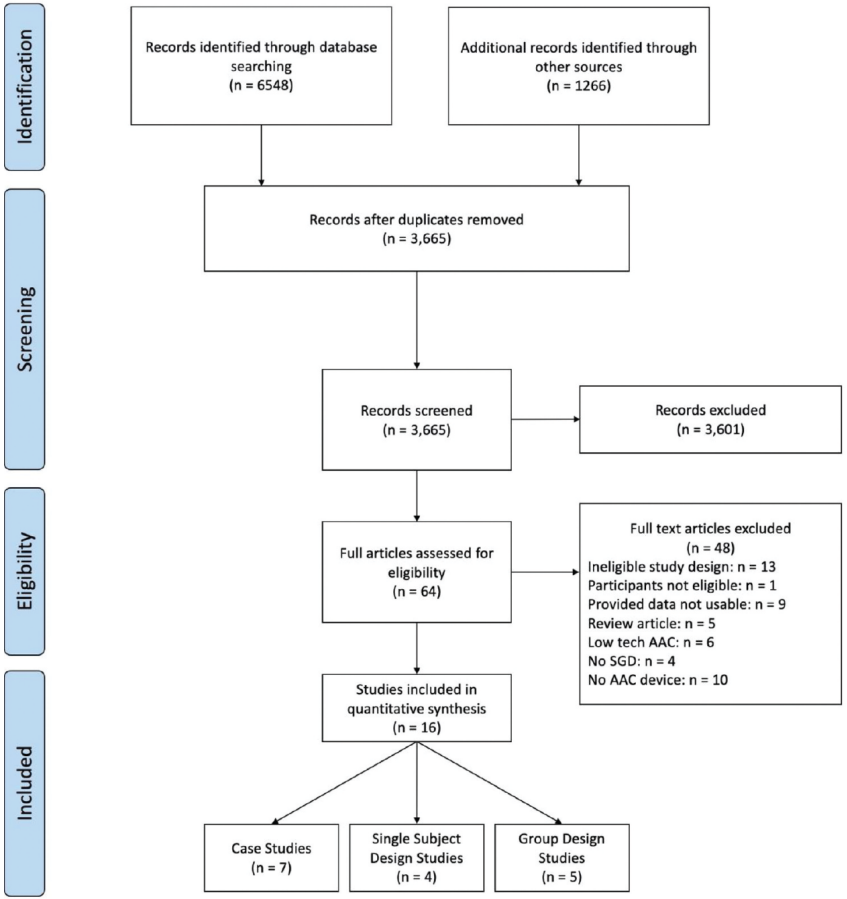
AAC implementation using SGDs and/or mobile technology applications.

Studies included dependent variables which related to a change in behavior observed secondary to AAC intervention.

Primary diagnosis of aphasia.

Statistical data from group and SSDs designs.

Methods -Search Strategies



ure 1. Flow chart depicting the records that were included/excluded during each phase.

Results

Participant Characteristics

- Aphasia diagnosis (n = 119)
- Broca's, transcortical motor, and global aphasia profiles (n=108)
- Severe aphasia (n=68)
- Moderate aphasia (n=20)
- Mild aphasia (n=3)
- Age (M = 56.91, SD = 9.70, range = 31-69.3)
- Gender (male = 70, female = 49)
- Education (M = 14.87, SD = 1.28, range = 13.2-16.8, 50% of studies did not report)
- Months post onset (range = 3 - 252)

Results

- ***Features of AAC Technology***
  - Dedicated SGDs (n = 5, 31%)
  - AAC software or apps (n = 11, 69%)
  - Visual scene displays (VSDs) (n=2, 12.5%)
  - Taxonomic grid displays (n=13, 81.25%)
  - Digitized speech (n=3, 18.75%)
  - Synthetic speech (n=12, 75%)

Results

Description of AAC Interventions

- Hospital settings- (n = 7, 43.75%)
- Home setting- (n=5, 31.25%)
- University clinic setting- (n=4, 25%).
- Long-term care facility- (n=1, 6.25%).
- Number of intervention sessions-1 to 48 (M = 18, SD = 15.99),
- Number of probes for dependent measures ranged from 25-205.
- Reported duration of study, <4 to 24 weeks.

Results

Summary of Intervention Outcomes

- Syntactic Complexity (Koul et al., 2005; Koul et al., 2008; Koul & Harding, 1998)
  - Participants identified noun symbols with a higher accuracy in comparison to symbols from other word classes (NAP = 1.0, strong effect).
  - All participants identified verbs (NAP = 0.9884, strong effect) and subject verb combinations (NAP = 0 .9972, strong effect)
  - With the assistance of a SGD, persons with Broca's or global aphasia are able to locate and combine graphic symbols to produce phrases and sentences of varying degrees of syntactical complexity
- Unaided Versus Aided AAC Interventions
  - C-Speak Aphasia (NAP = 0.6901, medium effect). Overall results indicated that performance across all tasks and participants was superior when using C-Speak Aphasia in comparison to their performance when they did not use C-Speak Aphasia. (Nicholas et al. , 2005)
  - AAC-induced language recovery- both the AAC treatment group and the usual care group demonstrated an overall decrease in aphasia severity on the WAB- Revised, Aphasia Quotient following treatment (d = 0.27). The AAC treatment group, however, trended to have a greater decrease in severity (Dietz et al., 2018).

Results

- Dependent Measures; Functional Communication Tasks vs. Structured Contrived Tasks
  - ***n=8 (50%)-***structured contrived task.
  - n=7 (43.75%)-functional communication tasks.
  - n=1-both functional communication tasks and structured contrived tasks.
- Outcomes related to display features and navigation- n=4 (25%)
- Acceptance of an AAC Device- n=4 (25%)

Results

Methodological Appraisal of the Studies

- Case studies were not appraised for their methodological quality
- Of the included SCEDs and group studies:
- Three were appraised as providing conclusive evidence (i.e., Koul et al., 2005; Dietz et al., 2018; Petroi et al., 2014).
- Two studies were appraised as providing preponderant evidence (Koul et al., 2008; Koul & Harding, 1998).
- Two studies were classified as providing suggestive evidence (Bartlett et al., 2007; Nicholas et al., 2011) due to minor design flaws and no TI and IOA data.
- Two studies were appraised as providing inconclusive evidence (Nicholas et al., 2005; Steele et al., 2010). These studies had serious threats to internal validity as well as lack of TI and IOA data.

Conclusions

- SGD based AAC interventions are effective in facilitating positive change in functional communication measures as well as measures related to effectively accessing and using SGDs.
- Critical need for a greater number of well-controlled studies that evaluate both generalization and maintenance across communicative contexts.
- Lack of consistency in design and methodology across studies, and paucity of controlled studies on efficacy and effectiveness of AAC interventions preclude strong predictions about the efficacy of SGD based AAC interventions in PWA.
- AAC intervention that involves multimodalities and is based upon the communication participation model seems to enhance communicative effectiveness and efficiency of individuals with aphasia.

Advances in AAC Technology for Adults with Aphasia: Primary Themes

- Cognitive processing and AAC
- Allocation of cognitive resources in relation to use of speech output technologies
- AAC Interface displays
- Efficacy of speech output technologies in AAC intervention
- **Social validation framework**

Social Validation

A procedure of evaluating the social significance of goals, methods, and outcomes

(Kazdin, 1997; Schlosser, 1999; Wolf, 1987)

How do we determine if a particular intervention is socially valid?

- Direct Stakeholders = Persons with Aphasia (PWA)
- Indirect Stakeholders = Persons strongly affected by intervention
- Immediate Community Stakeholders = Persons who regularly interact with direct or indirect stakeholders
- Extended Community Stakeholders = Persons in community who rarely or never interact with direct or indirect stakeholders

Purpose of this Study

Evaluate caregivers' and participants' perception of

- Changes in communicative behavior and quality of life following an AAC intervention program.
- Overall effectiveness of the AAC intervention program.

Methods

Participants

- Persons with aphasia (PWA): 10 females, 5 males + their caregivers/communication partners (CPs)
- Mean age = 64.6 years
- Range = 32-86 years
- Months post onset brain injury = 13-105
- Chronic severe Broca's aphasia* = 13
- Global aphasia* = 2
- Living with family =10
- Long term care = 5

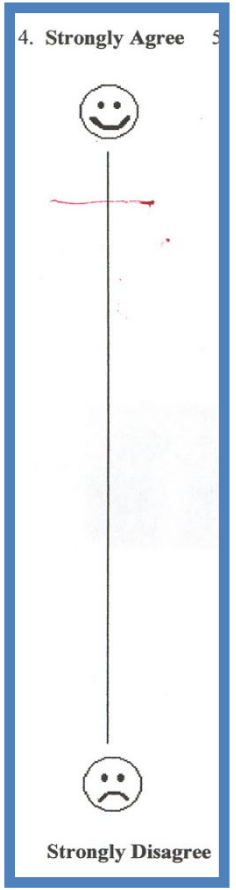
* BDAE (Short-form) Goodglass & Kaplan (1983)

Methods

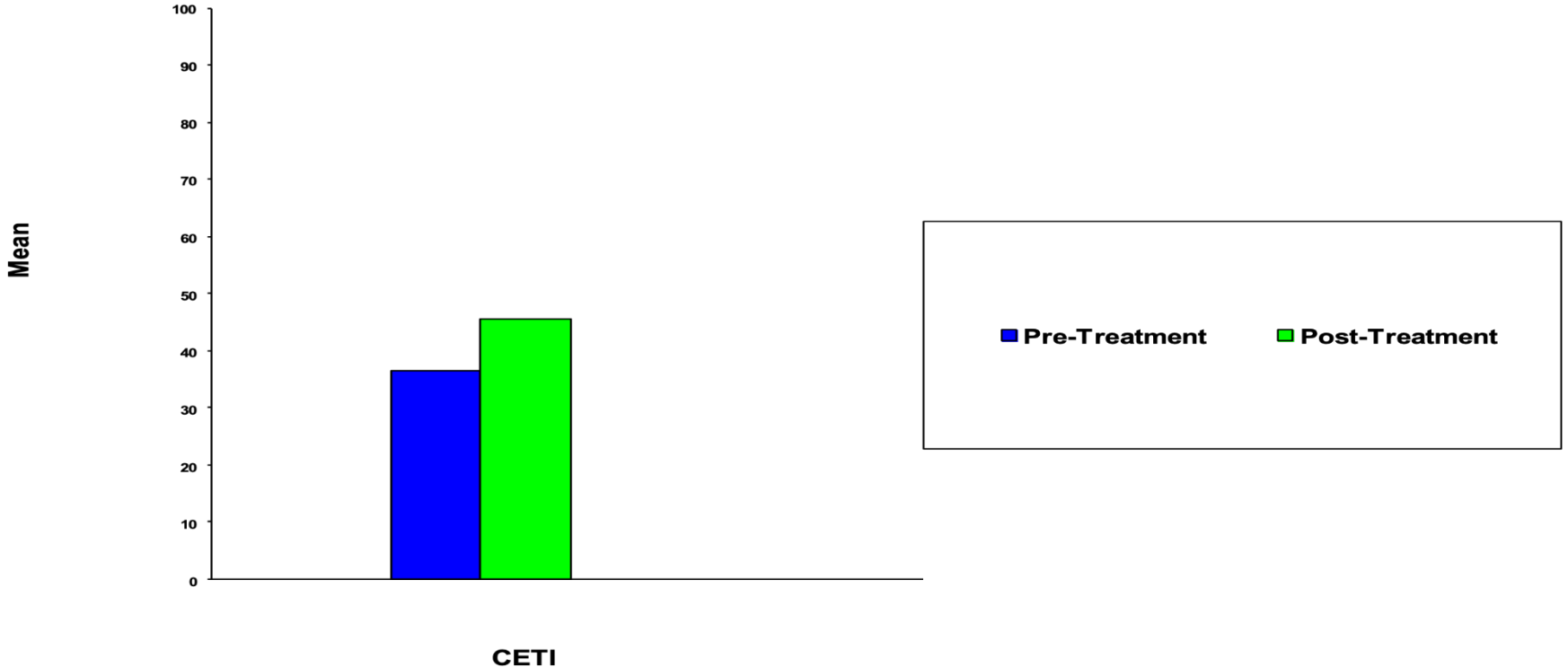
- **Experimental Design**
  - Within-Groups
  - Dependent t-tests were performed for each scale
  - Descriptive analysis was conducted for the PEI-Short Form.
  - Qualitative analysis of caregiver interviews

Methods

- **Experimental Procedures**
  - Pre AAC Intervention
  - Phase 1
  - Phase 2
  - Post AAC Intervention
  - Scales Used
    - The Communicative Effectiveness Index (CETI) instrument (Lomas et. al, 1989)
    - Communication Readiness & Use Index (CRUI)
    - Psychosocial Well-Being Index (PWI) (Lyon et al., 1997)
    - Program Evaluation Instrument—Short Form (PEI-SF) (Kelley, Heffer, Gresham, & Elliot, 1989)
  - Structured Interviews



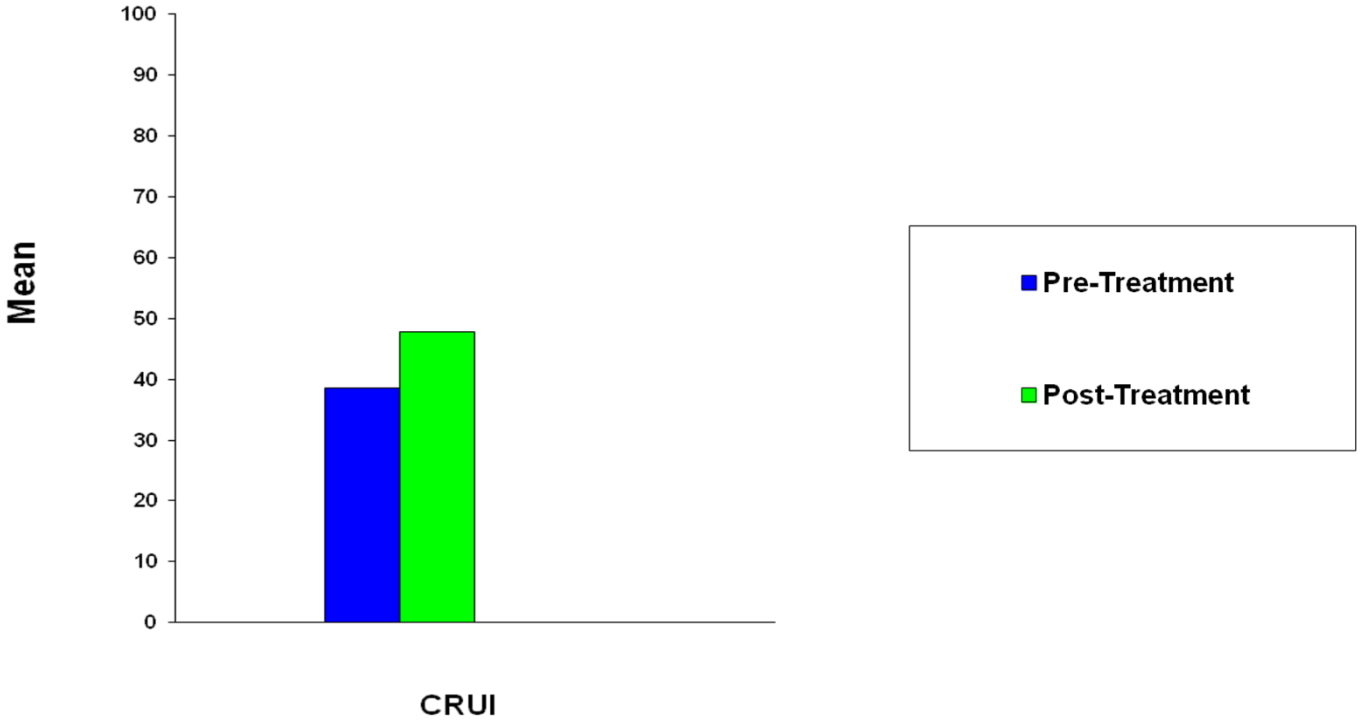
Mean Pre & Post Communicative Effectiveness Index (CETI) Scores



Results: CETI

- The caregivers' perception of the participants' communicative effectiveness increased significantly after AAC intervention.
- Paired t-test results revealed a significant change [$t(1, 14) = -3.335$, $p<.01$] between pre and post intervention scores.
- Power of the performed test with $\alpha = .05$ was .854.

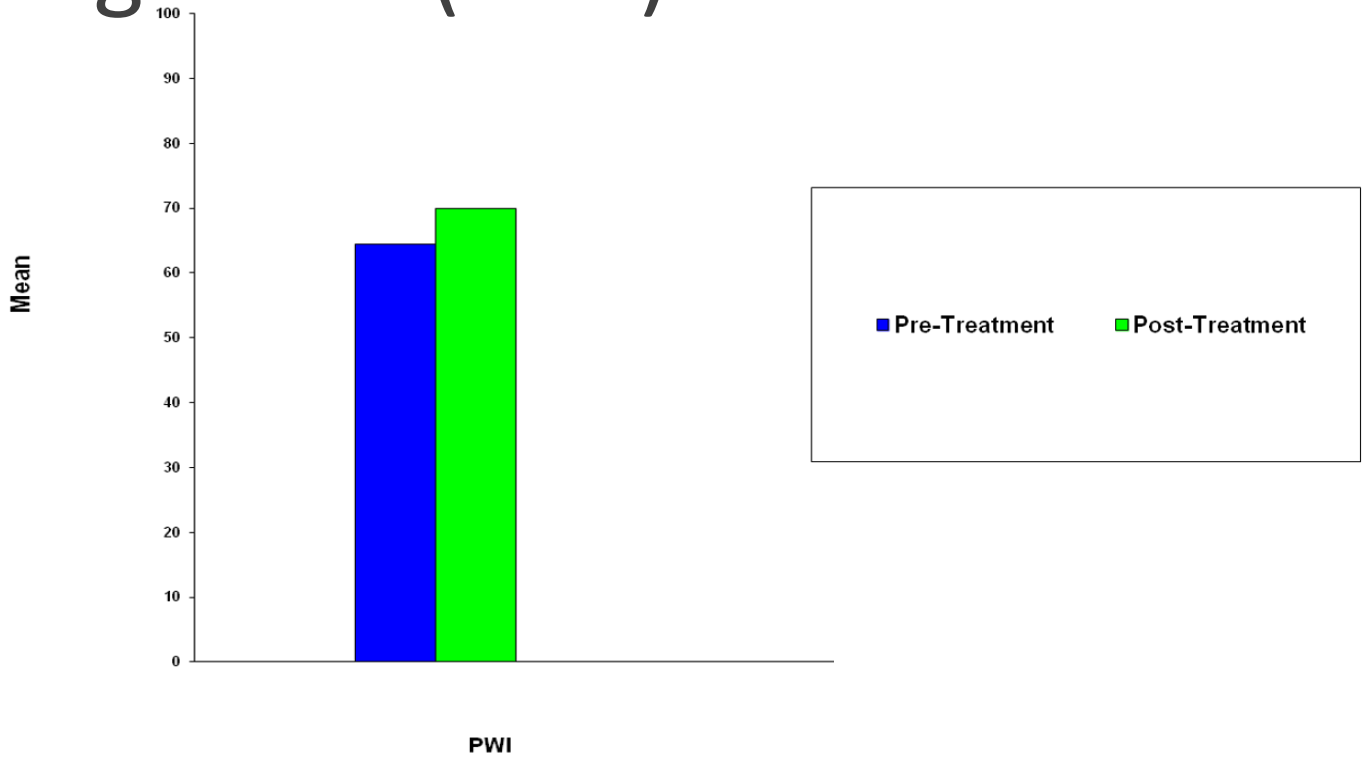
Mean Pre & Post Communication Readiness and Use Index (CRUI) Scores



Results: CRUI

- Caregivers' perception of the participants' communicative effectiveness increased significantly after AAC intervention
- Paired t-test results revealed a significant change [$t(1, 14) = -3.043$, $p<.01$] between pre and post intervention scores
- Power of the performed test with $\alpha = .05$ was .772

Mean Pre & Post Psychosocial Well-Being Index (PWI) Scores



Results: PWI

- No significant changes were noted by participants in their psychosocial well-being before and after AAC intervention.
- Paired t-test results indicated no significant difference [$t(1, 14) = -1.648$, $p>.10$] between pre and post scores.
- Power of the performed test with $\alpha = .05$ was .219.

Qualitative Data

Caregiver Interview—Transcript Sample 1

Most of the time it is very frustrating because he's trying to tell me something and I don't understand. Sometimes he can get the word out if he can just give me a one-word clue…I can get him to go from there. If you just have an area to start with, if you just don't have a clue, then you've got the whole world to think about. But most of the time it's pretty frustrating…

Qualitative Data

Caregiver Interview—Transcript Sample 2

He was trying to tell me something once and I wasn't sure what he was trying to say and he found a car on [the DynaVox] and he wanted to go get the oil changed in the car…and he found that…so I had an area to go to. So, I started going through things he might want to do with his pickup and I think one time he wanted me to get something for him and he couldn't get it across and he found a picture of it in there. So for something like that, [the DynaVox] was good, but I don't know if he would ever use it as far as just sitting down and carrying on a conversation. But I think it does help him as far as recognizing words. Especially I think it helps him in his reading because he can go through words and sentences.

Qualitative Data

Caregiver Interviews—Transcript Sample 3

[The researcher] put in a lot of personal things and…when he was trying to tell me something and I couldn't understand what he was saying, he found the people on [the DynaVox]…or the family…where she had programmed all the family members' names and he found the name that he wanted. I couldn't figure out who he was talking about…trying to talk about or ask about…and he found the name in there. And so, for things like that, [the DynaVox] can come in handy.

Qualitative Analysis

Themes/Perceptions:

- Pre-treatment frustration on the part of PWA and communication partners
- AAC Device was helpful at certain times for word/concept retrieval
- Limited use of device for conversations even after treatment

Summary

- Following AAC intervention, caregivers perceived positive changes in variables involving communicative effectiveness; PWA perceived positive changes in variables involving communication readiness and use.

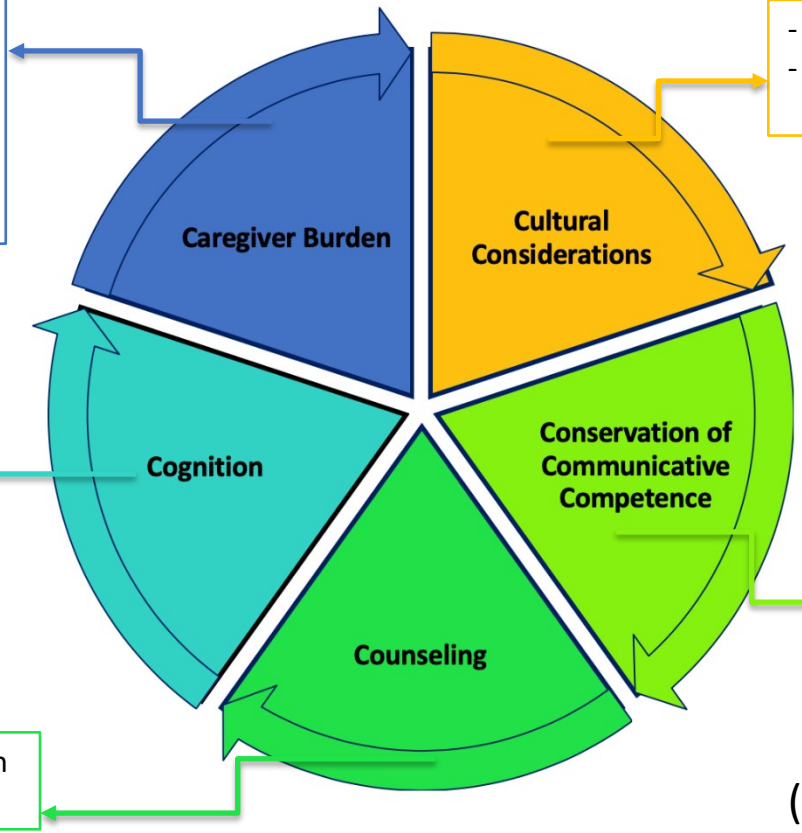
- Both the PWA and their caregivers believed that AAC intervention employed acceptable treatment procedures and goals, and there was high satisfaction with the treatment program.

Gaps in Research

- No valid way to assess the ‘goodness’ of communicative partners (CPs)
- No data on whether some CP training techniques are ‘better’ than others
- Do different groups of CPs need different training?
- Need multiple stakeholder perspectives

Five Cs for Consideration during AAC Assessment and Intervention

- Cognitive decline exacerbates caregiver burden
- a fear of learning new technology
- identify another family member or friend who is willing to take responsibility for AAC supports



- The holidays, rituals, and religion
- Clinician's willingness to learn and to expose one's vulnerability

- Cognitive decline
- Anticipate additional cognitive challenges to planned interventions
- The AAC option that is used regularly
- Every high technology option requires a low technology back up

- Communicative competence decline leads to social withdrawal and social isolation
- Consider the interaction of the Five Cs
- Provider AAC supports to preserve communicative competence

- Violation of expectation
- Ambiguous loss

(Gutmann & Koul, 2023)

Myths and Realities

- **Myth #1**: Since each person's aphasia is different, general principles of AAC intervention do not apply.
- **Reality:** Although language profiles and levels of impairment differ across various types of aphasia, general principles of AAC intervention can and should be applied to aphasia.

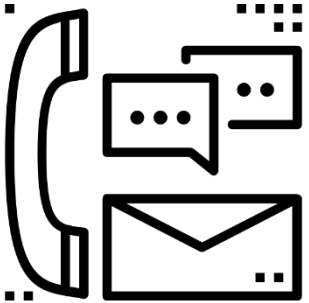
- **Myth #2:** If cognitive decline is part of a neurodegenerative disease, it precludes AAC intervention. Besides, most people become non-verbal and do not interact that much with those around them as the disease progresses. (Think about Primary Progressive Aphasia)
- **Reality:** It is ideal to intervene before there is a precipitous decline in cognition, so that people can rely on procedural memory to facilitate learning and mastery of AAC. However, if that does not happen, for whatever reason, it is still appropriate to introduce AAC options to facilitate maintenance of existing communication skills.

- **Myth #3:** If a person did not embrace technology before having a stroke or being diagnosed with a neurodegenerative disease, they will certainly not do so for the sake of AAC intervention.
- **Reality:** Demonstration and evaluation of AAC options, both low- and high-tech, may sway a potential user's opinion. Adoption of AAC is a multifactorial decision.

Contact Us

❖ Rajinder Koul

rajinder.koul@austin.utexas.edu



❖ AAC Lab at UT Austin

https://slhs.utexas.edu/research/augmentative-and-alternative-communication-lab

References

Brock, K., Koul, R., Corwin, M., & Schlosser, R. (2017). A comparison of visual scene and grid displays for people with chronic aphasia: a pilot study to improve communication using AAC. *Aphasiology, 31,* 1282-1306.

Brock, K., Koul, R., Corwin, M., & Schlosser, R. (2019). The psychometric properties of the communicative competence scale for individuals with Aphasia using speech generating devices. *Aphasiology, 33,* 520-543.

Garrett, K., & Huth, C. (2002). The impact of graphic contextual information and instruction on the conversational behaviors of a person with severe aphasia. *Aphasiology, 16*(4-6), 523-536.

Garrett, K., & Lasker, J. (2005). The Multimodal Communication Screening Test for Persons with Aphasia (MCST-A). In. Downloaded from https://cehs.unl.edu/aac/aphasia-assessment-materials/ on June 18, 2019.

Garrett, K., & Lasker, J. (2007). AAC and severe aphasia - enhancing communication across the continuum of recovery. *Perspectives on Neurophysiology and Neurogenic Speech and Language Disorders, 17*(3), 6-15.

Gutmann, M. L., & Koul, R. (2023). AAC Intervention for Persons with Acquired Disorders, In D. Fuller (Ed.*). Principles and Practices in Augmentative and Alternative Communication*. Slack Incorporated.

Koul, R. K., Corwin, M., & Hayes, S. (2005). Production of graphic symbol sentences by individuals with aphasia: Efficacy of a computer-based augmentative and alternative communication intervention. *Brain and Language, 92,* 58-77.

Koul, R., & Harding, R. (1998). Identification and production of graphic symbols by individuals with aphasia: Efficacy of a software application. *Augmentative and Alternative Communication*, *14*(1), 11-24.

Koul, R. K., & Corwin, M. (2003). Efficacy of AAC intervention in individuals with chronic severe aphasia. *The efficacy of augmentative and alternative communication: Toward evidence-based practice*, 449-470.

Koul, R., Corwin, M., & Hayes, S. (2005). Production of graphic symbol sentences by individuals with aphasia: Efficacy of a computer-based augmentative and alternative communication intervention. *Brain and language*, *92*(1), 58-77.

Koul, R., Corwin, M., Nigam, R., & Oetzel, S. (2008). Training individuals with chronic severe Broca's aphasia to produce sentences using graphic symbols: implications for AAC intervention. *Journal of Assistive Technologies*, *2*(1), 23-34.

Koul, R., Petroi, D., & Schlosser, R. (2010). Systematic review of speech generating devices for aphasia. In *Computer synthesized speech technologies: Tools for aiding impairment* (pp. 148-160). IGI Global.

Petroi, D., Koul, R., Corwin, M. (2014). Effect of number of graphic symbols, levels, and listening conditions on symbol identification and latency in persons with aphasia. *Augmentative and Alternative Communication, 30,* 40-54.

Rayer, K., Chavers, T., Schlosser, R., & Koul, R. (2022). Efficacy of Speech Output Technologies in Interventions for Persons with Aphasia: A Scoping Review. *Aphasiology*, 1-23.

Shakila, D., Stockley, N., Wallace, S., & Koul, R. (2019). The effect of augmented input on the auditory comprehension for persons with aphasia: A pilot investigation. *Augmentative and Alternative Communication*, *35*, 148-155.