

# Toward a Measure of Working Memory in Aphasia

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## INTRODUCTION

- A deficit in working memory (WM) capacity may contribute to the language processing difficulties of individuals with aphasia (Caspari, Parkinson, LaPointe, & Katz, 1998; Tompkins, Bloise, Timko, & Baumgaertner, 1994; Lehman & Tompkins, 1998; Wright, Newhoff, Downey, & Austermann, 2003).
- Several verbal WM tests are patterned after Daneman & Carpenter's Reading Span Task (1980), a task not intended or designed for individuals with aphasia (c.f., Caplan & Waters, 1999; Caspari et al., 1998).
- Traditional WM tasks often fail to differentiate between individuals with aphasia with relatively large WM capacity who are unable to orally repeat words due to verbal output difficulties, and individuals with aphasia who possess fluent speech but have a relatively limited WM capacity.
- There has been no systematic comparison of *PRESENTATION MODE* and *RESPONSE TYPE* for WM in aphasia.
- Measures designed to target WM in individuals with other neurogenic disorders are inappropriate for individuals with aphasia (Tompkins et al., 1994; Lehman & Tompkins, 1998).

## Purpose

- To examine the claim that WM deficits are responsible for language deficits.
- To investigate whether language deficits in aphasia can at least be partially explained by deficits in WM
- To examine, using a parametrically designed and controlled study, whether *PRESENTATION MODE* and *RESPONSE TYPE* affect performance on WM assessment in aphasia.

## METHOD

### Participants

- Participants included 10 adults with aphasia.
- Only single, unilateral lesions; native English speakers; 6 months post onset; pre-morbid right-handed; and no history of dementia or other neurological illness.
- Type of aphasia was determined by performance on the WAB or BDAE: Broca's aphasia (N=4), conduction aphasia (N=4), apraxia of speech (N=1) and anomia (N=1).

Participant	Age	Sex	Months post CVA	WAB AQ	WAB Profile
1	62	F	24	80.1	Conduction
2	53	F	38	78.6	Broca
3	61	M	27	55.8	Broca
4	80	F	18	53.9	Anomic
5	76	F	9	68.16	Conduction
6	70	F	13	26	Broca
7	29	M	52	80.1	Conduction
8	64	M	27	52.9	Conduction
9	53	F	101	57.6	Broca
10	57	M	93	95.6	Apraxia

## Experimental Tasks and Variables

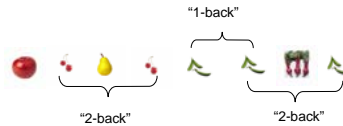
- 16 familiar and imageable fruit and vegetable stimuli
- Auditory and visual presentations
- Participants completed each task in both modalities

### Fruit Back: an N-back task

- 3 levels of task (increasing difficulty):
  - 0-back: Respond when a specific token is presented
  - 1-back: Respond when the current token is the same as the one immediately preceding it
  - 2-back: Respond when the current token is identical to the item appearing 2 tokens prior
- *PRESENTATION MODE*: Auditory and Visual
- *RESPONSE TYPE*: Button Press

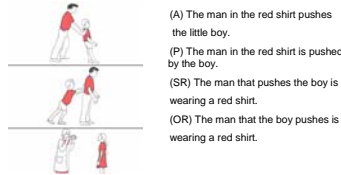
### Fruit Span: a memory span task

- Recall word or image sets of increasing size
- 10 sets presented at each span level (2-5 items)
- *PRESENTATION MODE*: Auditory and Visual
- *RESPONSE TYPE*: Verbal and Pointing



## Subject-relative, Object-relative, Active, Passive Test of Syntactic Complexity (SOAP) (Love and Oster, 2002): an auditory comprehension measure

- Measures auditory comprehension of 4 syntactic structures
- Sentences presented auditorily; participant points to picture that matches from a field of 3 (2 opposing actions, 1 foil).

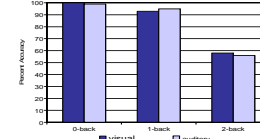


## RESULTS

### Fruit-Back

- **Fruit-Back accuracy** N = 8 (2 subjects unable to complete the 2-back); *PRESENTATION* (visual vs. auditory) x *N-back* (0, 1, 2)
  - 2-back < 1-back = 0-back (see chart below)
  - Interaction: not significant

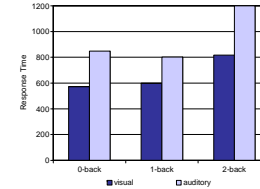
### Mean Percent Accuracy for the Fruit-Back



### Fruit-Back Response Time (RT):

- *PRESENTATION* x *N-back*:
  - 2-Back > 1-back = 0-back
  - Main effect for *PRESENTATION* (aud. vs. visual)
  - Interaction: not significant

### Mean RT for the Fruit-Back



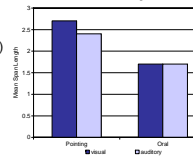
### Fruit-Span

- **Span length** N=9 (one subject unable to respond verbally)

*PRESENTATION* (aud. vs. vis.) x *RESPONSE* (pointing vs. oral)

- *PRESENTATION*: n.s.
- *RESPONSE*: Pointing > Oral
- Interaction: not significant

### Mean Span Length for Fruit-Span



## SOAP Comprehension Scores

WAB Profile	Active	Passive	Sub Rel	Obj Rel
Broca's (N=4)	88%	73%	75%	63%
Conduction (N=4)	80%	60%	75%	55%
Anomic (N=1)	70%	30%	70%	50%
Apraxic (N=1)	50%	50%	70%	20%

## SOAP and WM

Comparing Obj Rel constructions (the most WM-intensive component) and the Fruit Span tests. While there were no statistically significant correlations (most likely due to power), there are suggestive findings with the Broca's and Anomic (N5) participants.

**5 observations used in this computation	Visual Oral	Visual Pointing	Auditory Oral	Auditory Pointing
OR stims	-.725	-.062	-.622	-.029

## CONCLUSIONS

□ Consistent with findings in the *N-back* literature, as WM load increases (regardless of modality of *PRESENTATION*), performance worsens.

- > Participants appear to have unsuccessfully sacrificed speed for accuracy during the 2-back.
- > Interestingly, *PRESENTATION* modality did not affect participants' overall task performance.

**Purpose: "To investigate whether language deficits in aphasia can at least be partially explained by deficits in WM"**

□ The SOAP task shows decreasing accuracy as the sentence constructions get more difficult (Obj Rel).

- > The data for the Broca's and Anomic participants suggest a correlation between participants' ability to comprehend complex (WM intensive) sentence constructions and to respond to stimuli orally during this Memory Span Task.

□ The WM deficits revealed may affect the processing of longer or more complex sentences and discourse.

**Purpose: "To examine, using a parametrically designed and controlled study, whether PRESENTATION MODE and RESPONSE TYPE affect performance on WM assessment in aphasia"**

□ Reaction Time for the *VISUAL PRESENTATION* was **faster** at all levels of *N-back* as compared to the *AUDITORY PRESENTATION*.

□ Span lengths were significantly shorter when participants made oral responses.

We wish to acknowledge support from the following grants: NIH DC002984, NIH DC004494, NIH DC003660, & NIH DC003885