



# The Neural Correlates of Visual and Verbal Cognitive Styles

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## Introduction

- The notion that some individuals learn better with words and others with pictures has long existed in psychology and education.
- The two main ways this notion has been treated in formal research are:
  - Cognitive Styles
  - Cognitive Abilities
- Although putatively related to cognitive abilities, the neural correlates of cognitive styles are not well understood.
- Hypothesis: *Propensity for visual and verbal cognitive styles will correlate with recruitment of modality-preferential areas (those involved in visual/verbal working memory and processing).*

## Behavioral Measures

### Wechsler Adult Intelligence Scale (WAIS):

#### Verbal Comprehension Index

- Vocabulary
- Similarities
- Information

friend  
enemy

#### Perceptual Organization Index

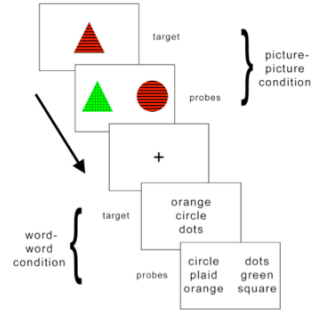
- Picture Completion
- Block Design
- Matrix Reasoning



### Verbalizer-Visualizer Questionnaire (VVQ):

- Verbalizer Dimension (10 items)
  - I prefer to read instructions about how to do something rather than have someone show me.
- Visualizer Dimension (10 items)
  - I seldom use diagrams to explain things.

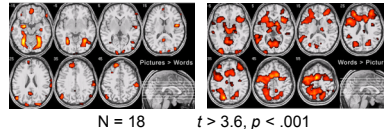
## fMRI Task



### Task Design Goals:

- Task can be completed using either a verbal strategy or a visual imagery strategy.
- Subjects have an incentive to *convert* from their non-preferred modality to their preferred modality (Incongruent Conditions).
- Performance should be comparable across both single-modality tasks, regardless of cognitive style.

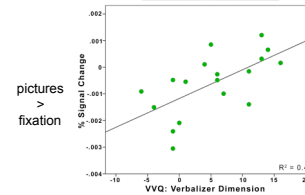
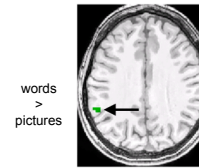
## Main Effects



- many regions active for each task, including those previously associated with visual or verbal working memory (Baddeley, 2003; Becker et al., 1999; D'Esposito, 2007; Hickok et al., 2003; Jonides et al., 1998; Paulesu et al., 1993; Postle et al., 2003; Rypma & D'Esposito, 1999)

## Individual Differences

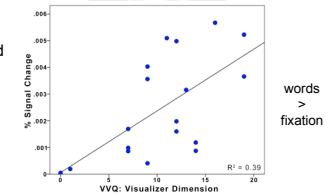
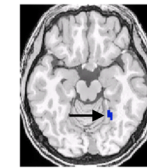
### Supramarginal Gyrus and Verbal Cognitive Style



**Modality-preferential cortex correlated with cognitive style during the non-preferred task.**

- Analysis focused on the single-modality conditions (word-word and picture-picture).
- ROIs taken from peaks in main effects contrasts.
- No effect in left fusiform ROI.

### Fusiform Cortex and Visual Cognitive Style



## Correlations

### Style and Ability Measures

	POI	VCI	POI - VCI	Visualizer	Verbalizer	Visualizer - Verbalizer
WAIS: Perceptual Organization Index	--	0.57*	0.46	0.09	-0.28	0.33
WAIS: Verbal Comprehension Index		--	-0.46	-0.28	0.06	-0.25
WAIS: POI - VCI			--	0.40	-0.37	0.63**
VVQ: Visualizer Dimension				--	0.29	0.45
VVQ: Verbalizer Dimension					--	-0.72**
VVQ: Visualizer - Verbalizer						--

\* indicates  $p < .05$ , \*\* indicates  $p < .01$ ; p-values calculated for two-tailed tests

### Left Supramarginal Gyrus ROI

	VVQ: Visualizer	VVQ: Verbalizer
Picture-picture Condition	.20	.63**
Word-word Condition	.23	.32
Fixation Condition	-.15	.43

### Right Fusiform Cortex ROI

	VVQ: Visualizer	VVQ: Verbalizer
Picture-picture Condition	.12	.07
Word-word Condition	.63**	.34
Fixation Condition	.36	-.17

## Conclusions

**Brain activity in picture-responsive and word-responsive regions tracked with cognitive styles:**

- Propensity for visual cognitive style correlates with converting verbally-presented information into visual representation (commensurate with activity in right fusiform cortex).
- Propensity for verbal cognitive style correlates with converting pictorially-presented information into verbal/phonological representation (commensurate with left supramarginal gyrus activity).

## Preliminary Data: Behavioral Interference

ongoing research collaborators: Ranjani Prabhakaran, Eric Myhre, Emily Singer

