
Executive Abilities in Individuals with Phenylketonuria

Desiree A. White, PhD

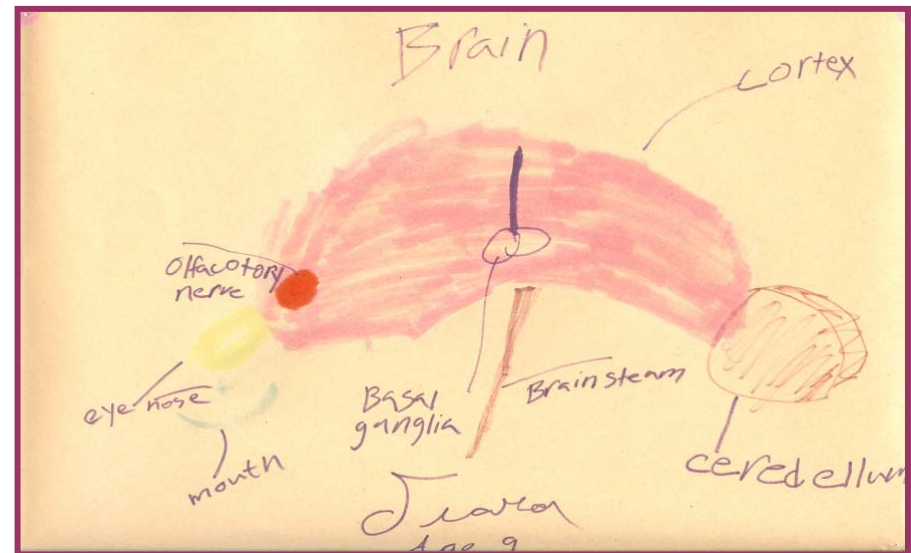
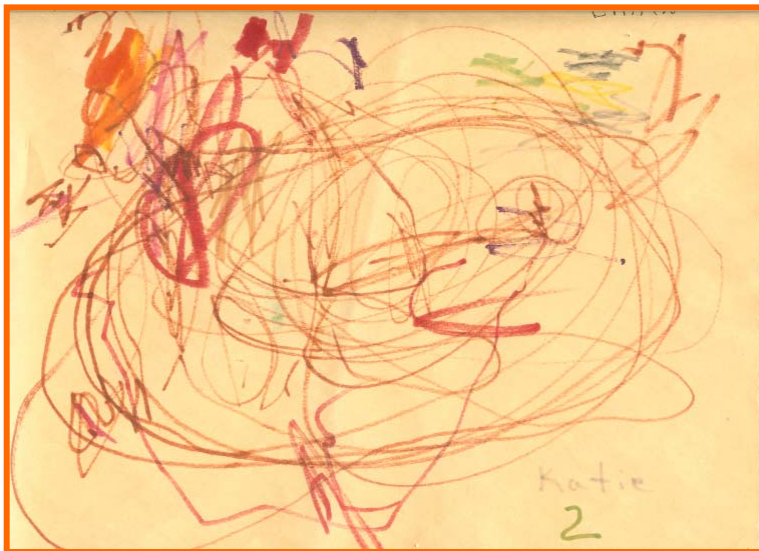


Research supported by National Institute of Child Health & Human Development and BioMarin Pharmaceutical Inc. Consultation and speaker fees accepted from BioMarin Pharmaceutical Inc. and Merck Serono International S.A.

Overview

- **Brain function**
- **Developmental trajectories**
- **Executive abilities**
- **Recommendations**
- **Discussion**

Brain Function



PKU and the Brain: Dopamine

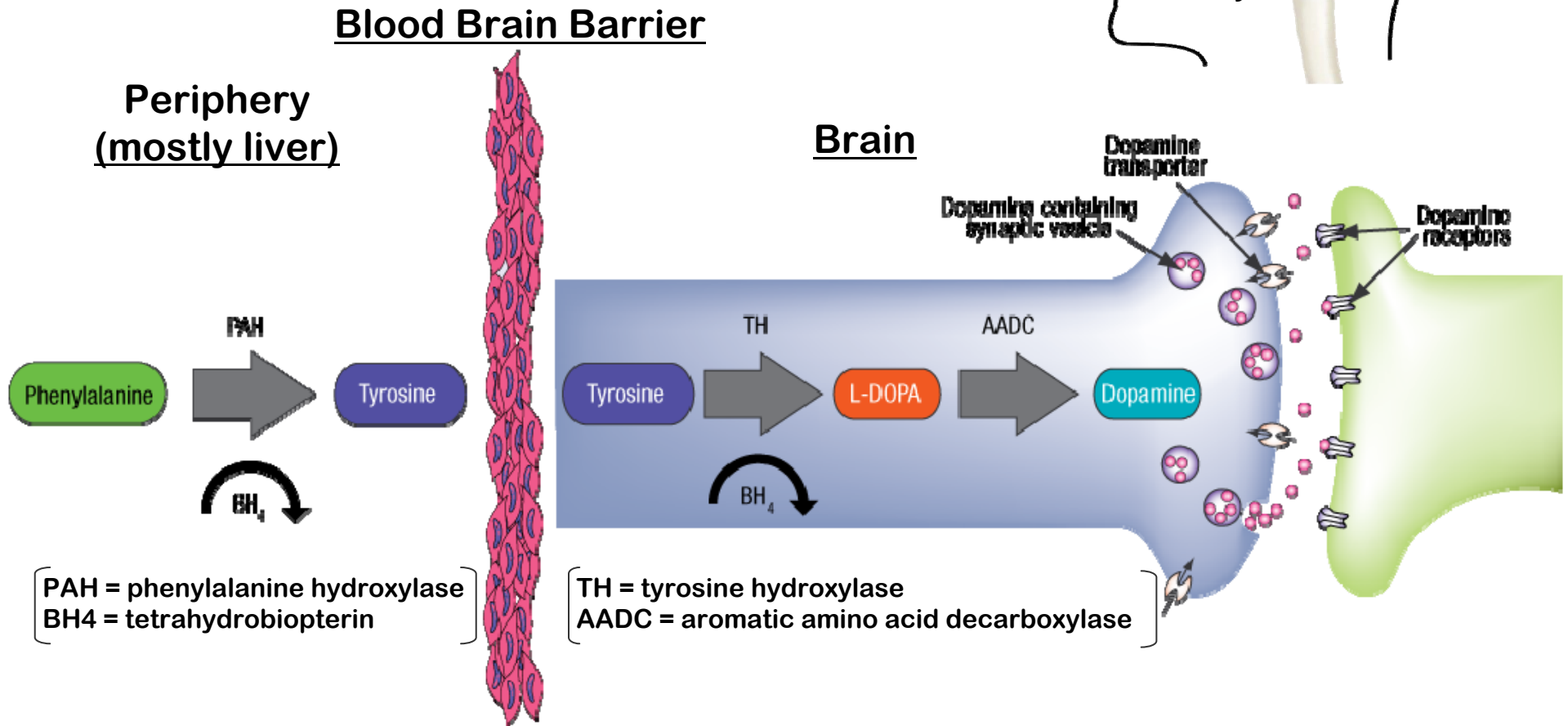
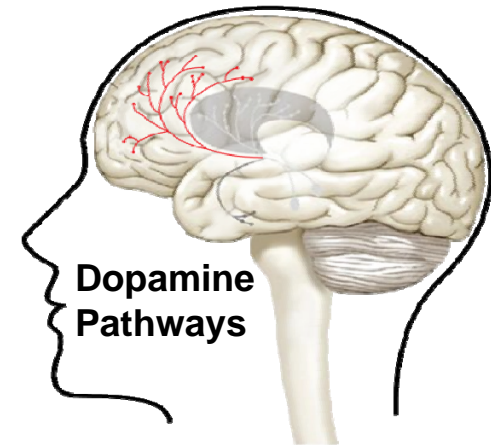
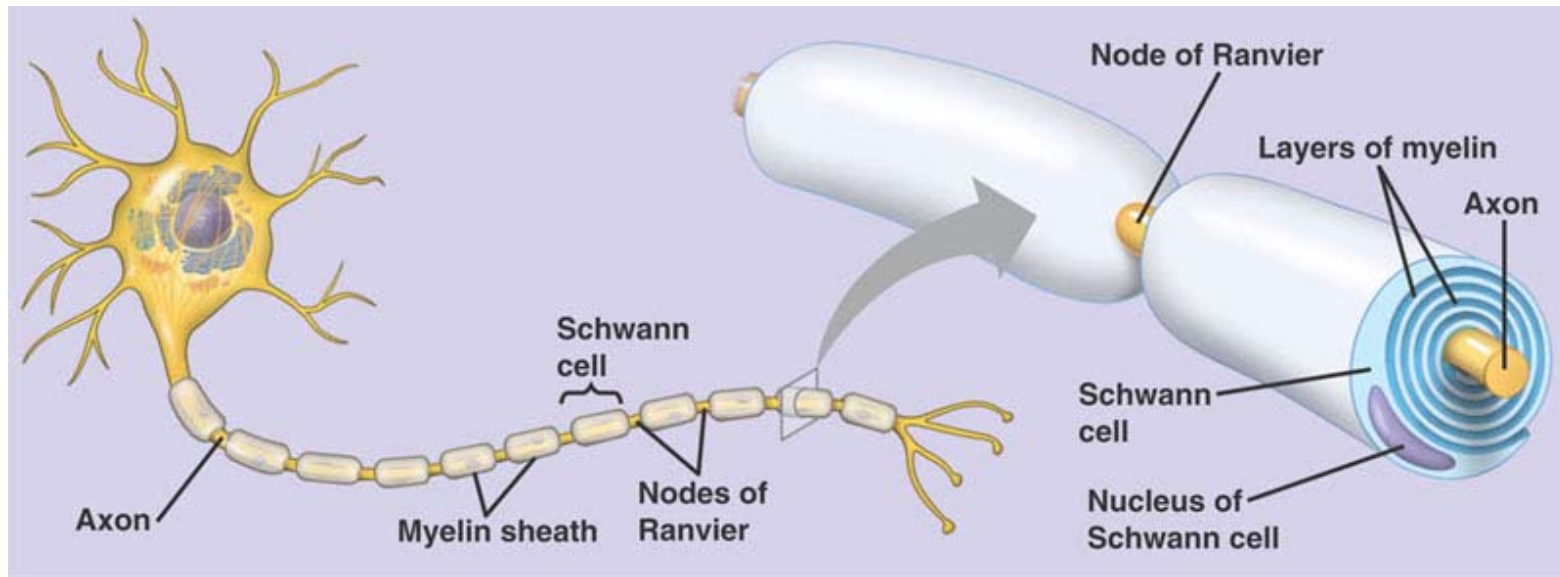
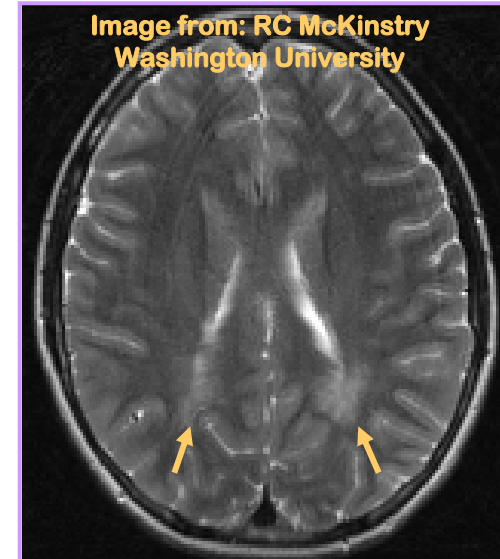


Figure adapted from Youdim et al 2006

Image from http://nobelprize.org/nobel_prizes/medicine/laureates/2000/press.html

PKU and the Brain: White Matter

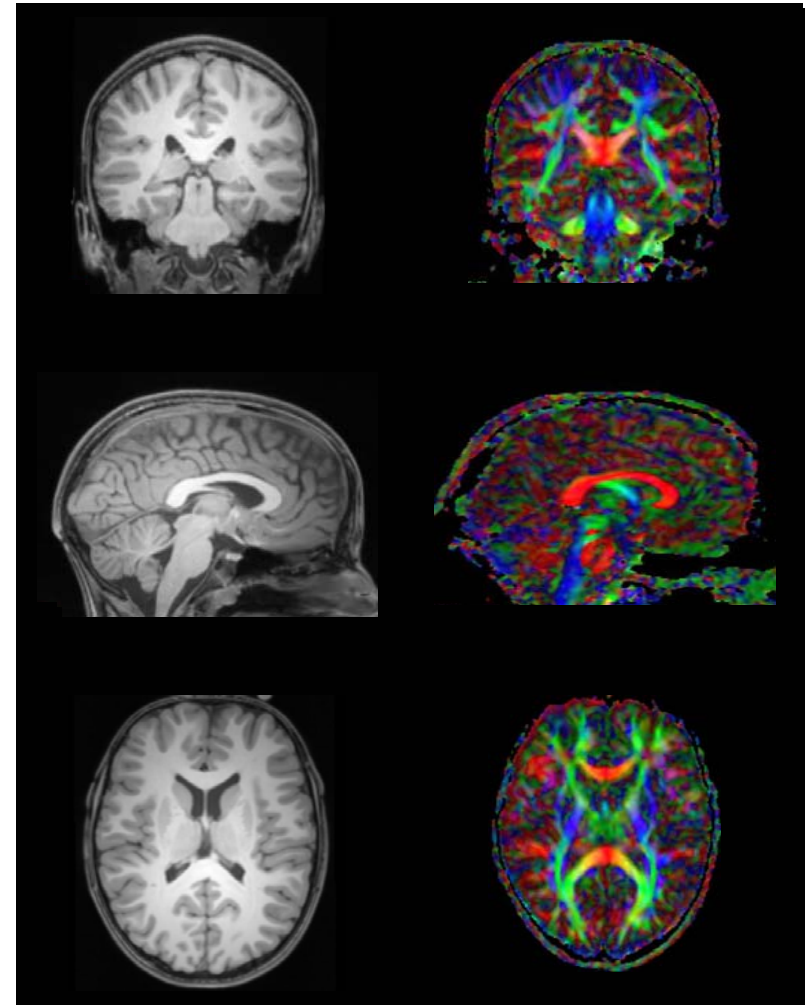
**Myelin increases speed
of neural transmission**



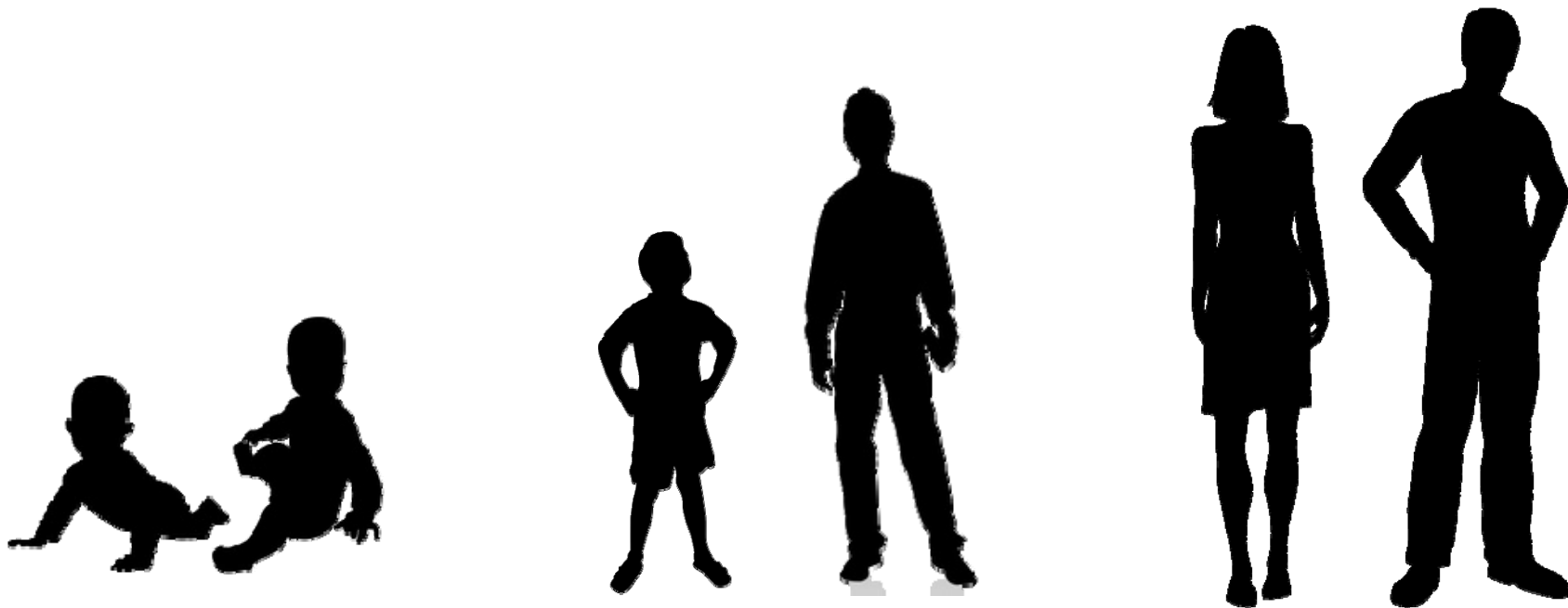
Examining White Matter Using Diffusion Tensor Imaging (DTI)

Brain Region
Prefrontal Cortex
Centrum Semiovale *
Parietal-Occipital Cortex *
Optic Radiation
Putamen
Corpus Callosum *
Thalamus
Hippocampus

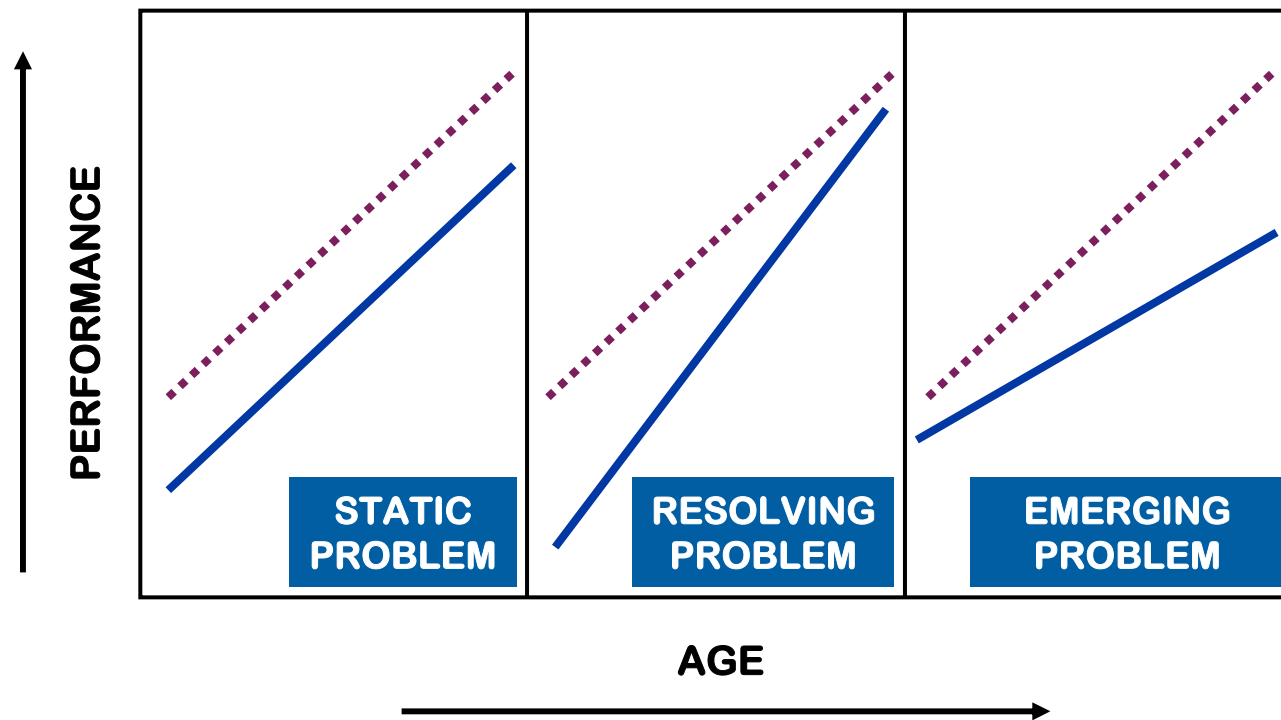
* Improvement following
BH4 treatment



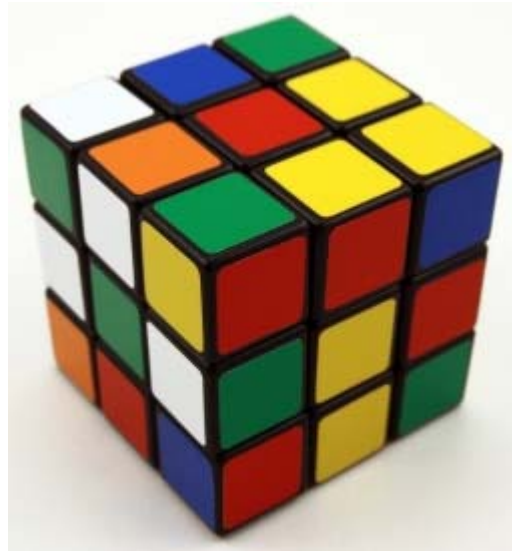
Developmental Trajectories



Developmental Trajectories in Cognition



Executive Abilities



Executive Abilities

- Subserved by prefrontal cortex & connections with other brain regions
- Maintenance & coordination of information processing leading to higher order thought
- Integration across sensory modalities & cognitive domains
- Executive subcomponents

**Inhibitory Control
Monitoring**

**Working Memory
Processing**

Response

Strategic

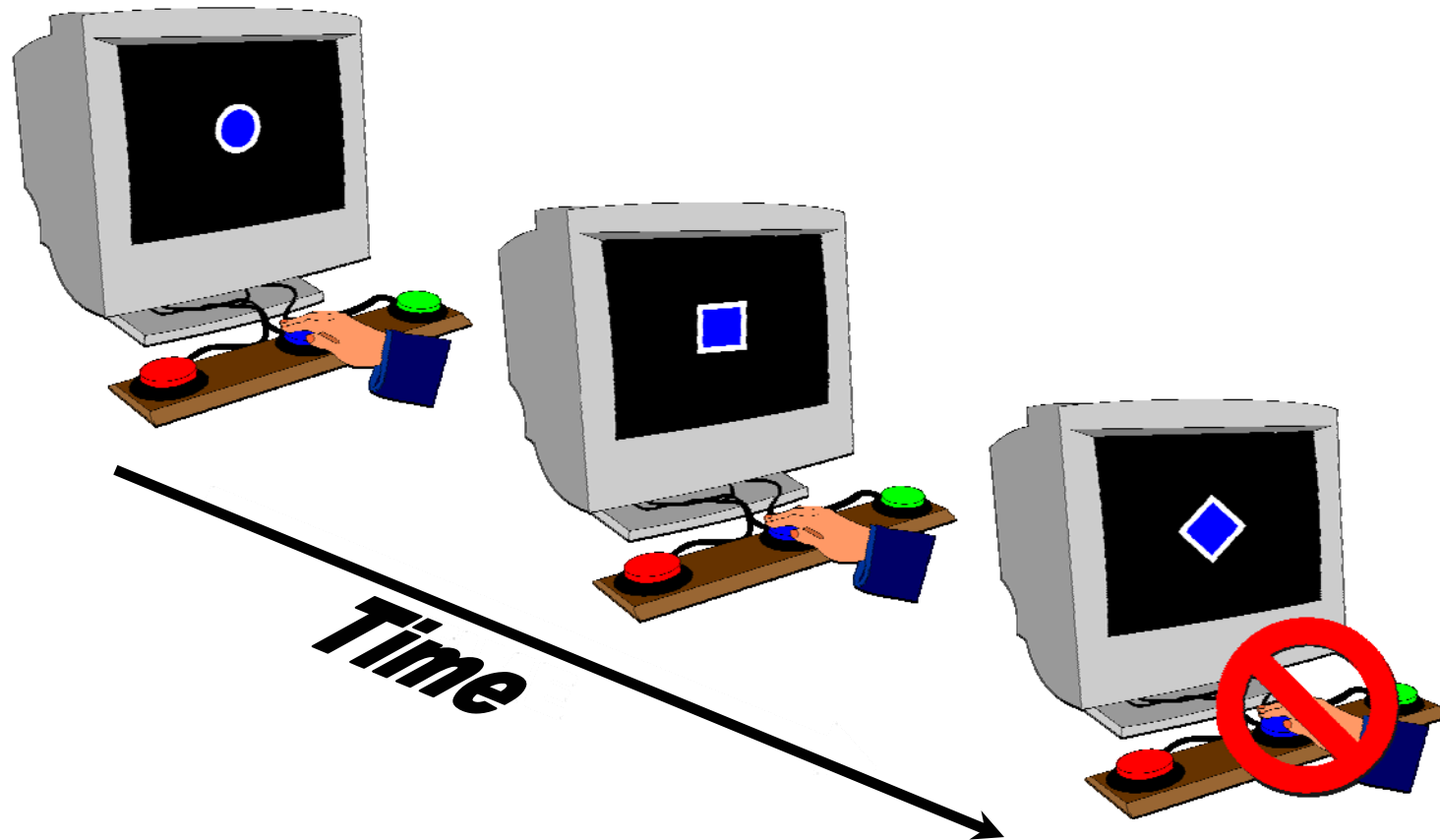
For a review see Christ, Huijbregts, de Sonneville, & White, 2010

Inhibitory Control

Suppressing the processing or expression of information that interferes with goal attainment

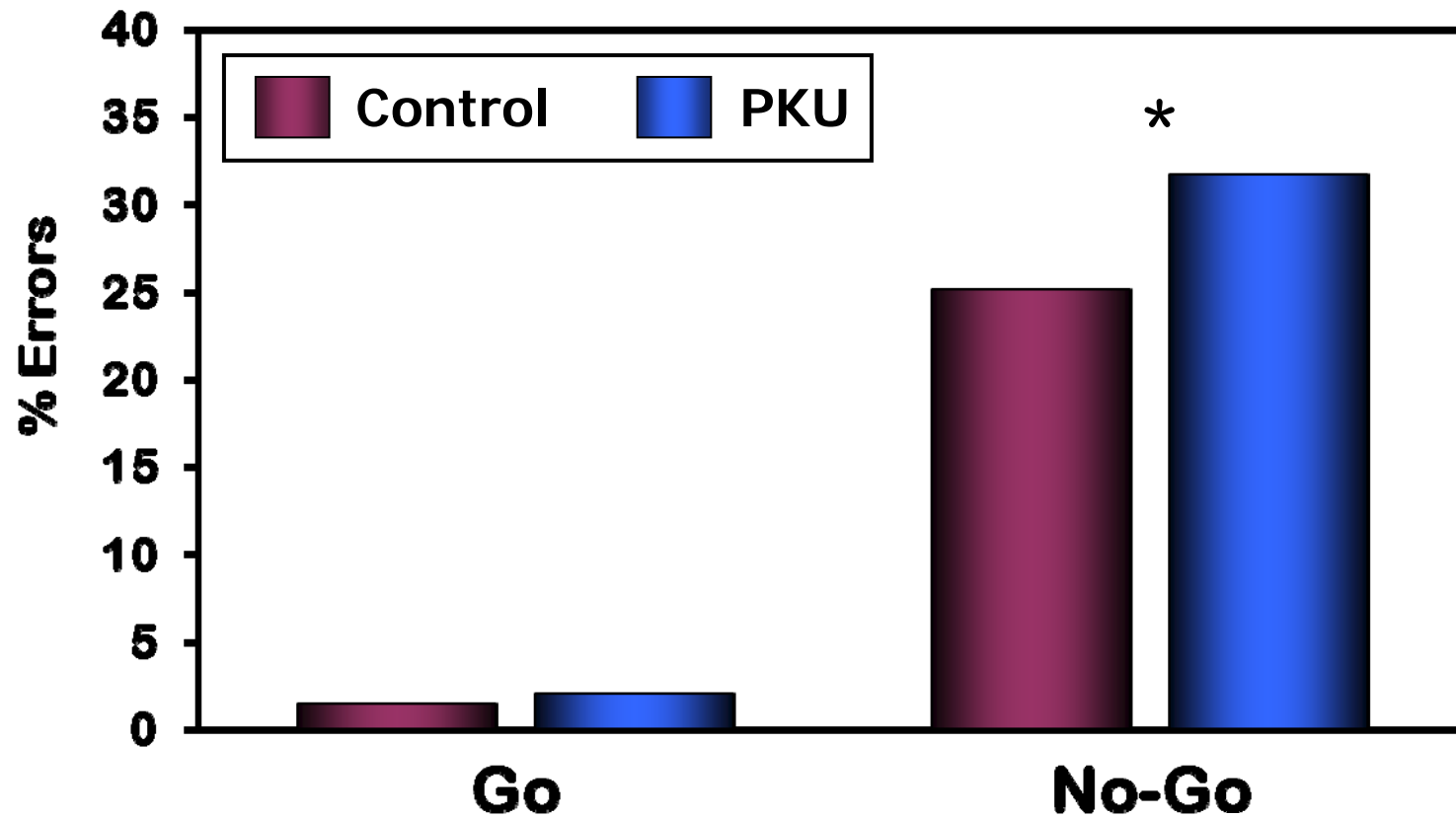


Inhibitory Control: Go-No-Go



Christ, Steiner, Grange, Abrams, & White, 2006

Inhibitory Control: Go-No-Go

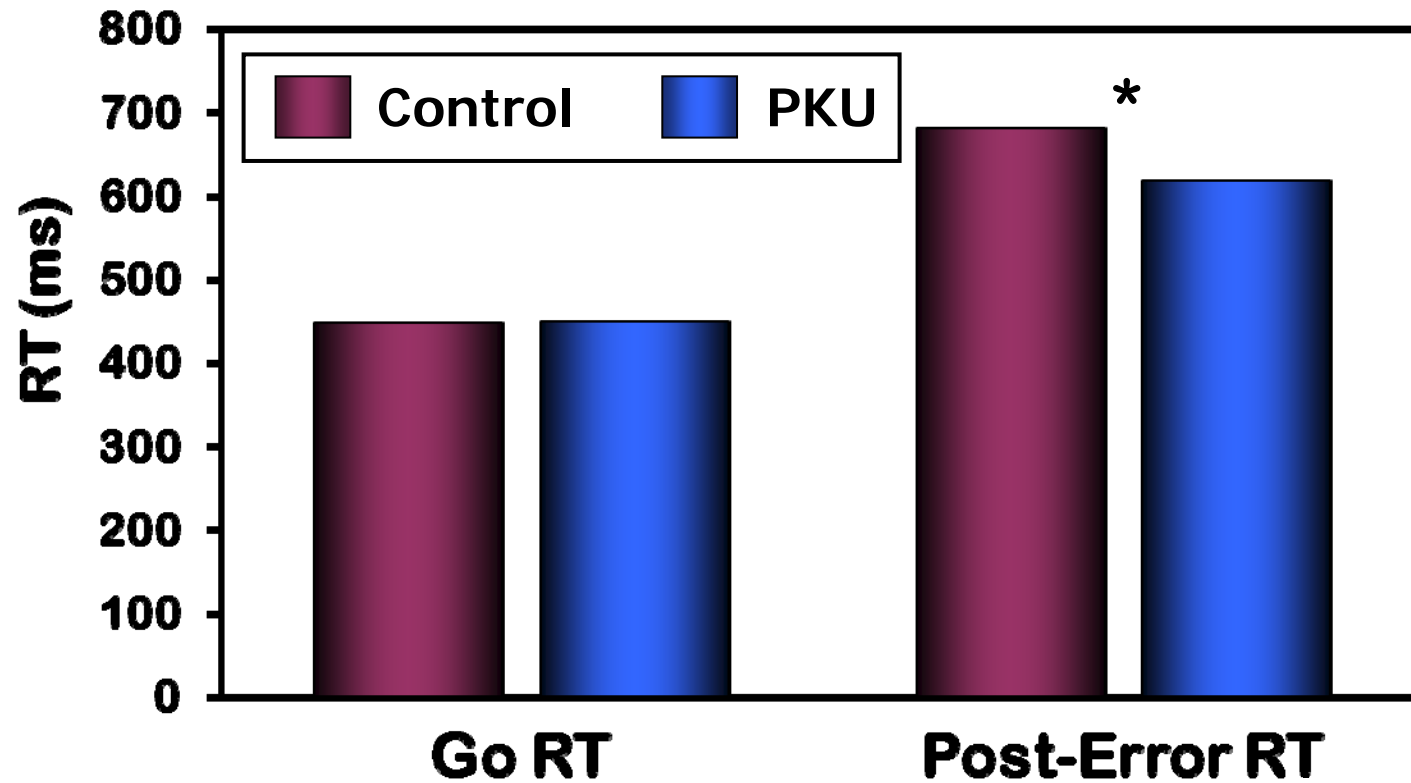


Response Monitoring

Detecting errors & making adjustments to improve performance



Response Monitoring: Go-No-Go



Working Memory

Maintenance & manipulation of information for brief periods

Important in a range of abilities

Vocabulary

Reading

Mathematics

Comprehension

Problem solving



Working Memory: Recognition Span

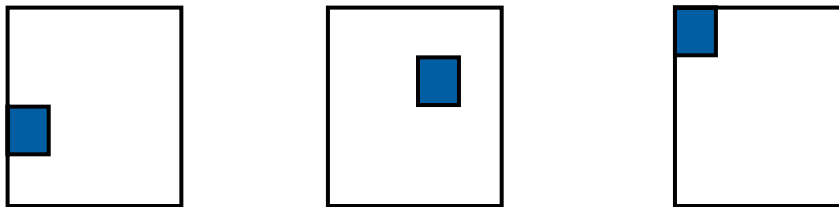
Letters

B N G

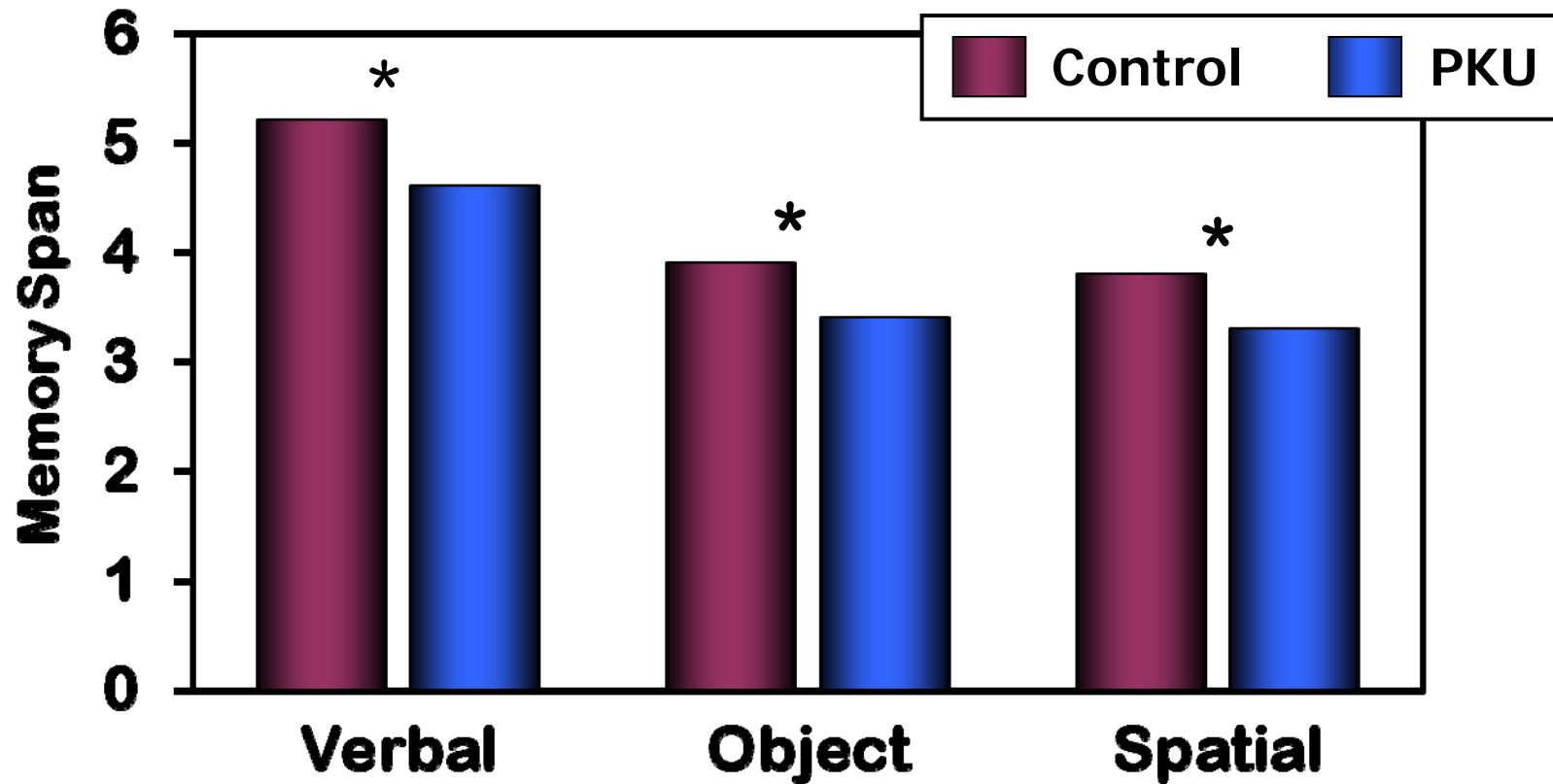
Objects



Locations

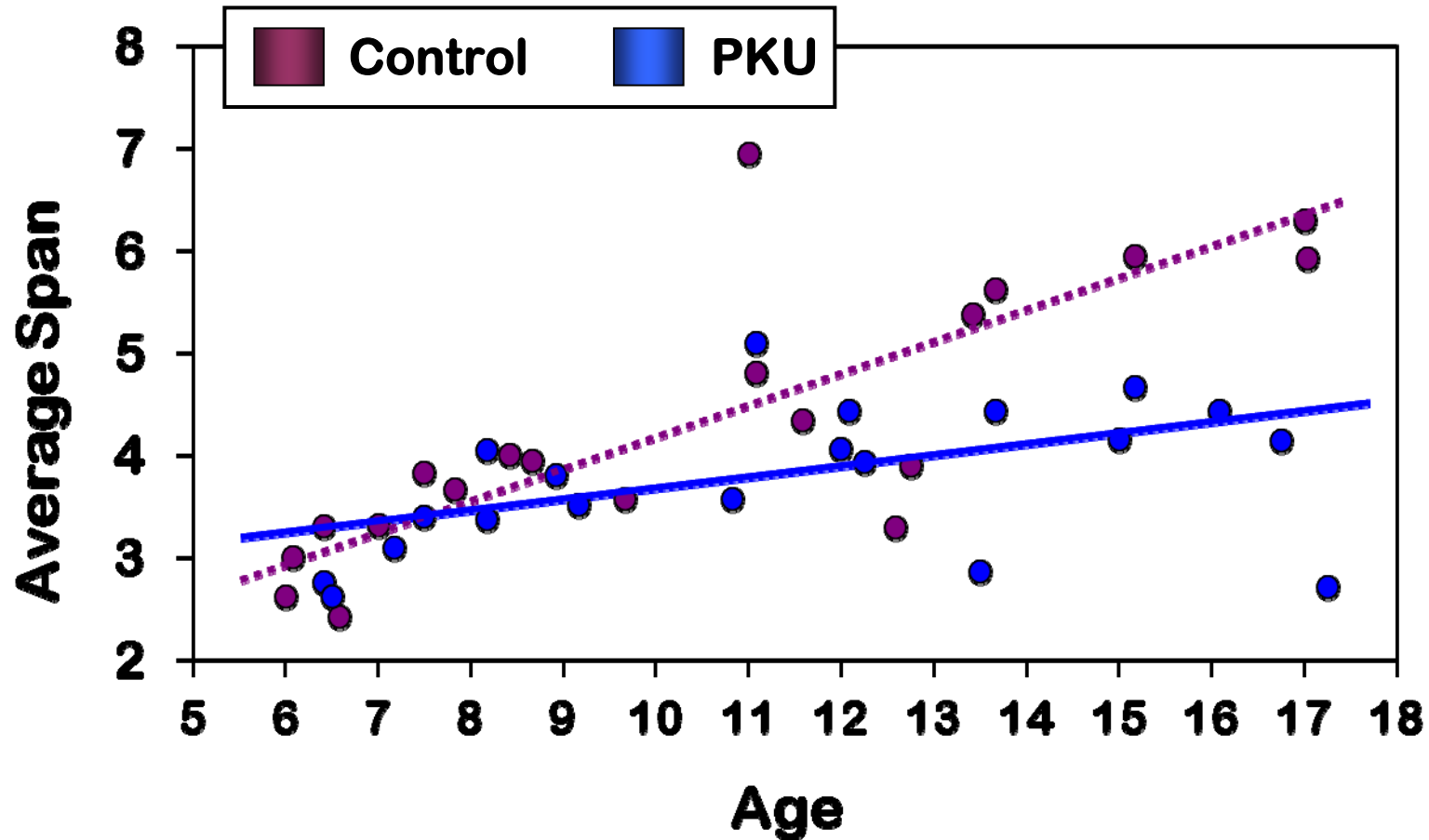


Working Memory: Recognition Span



White, Nortz, Mandernach, Huntington, & Steiner, 2002

Working Memory: Recognition Span



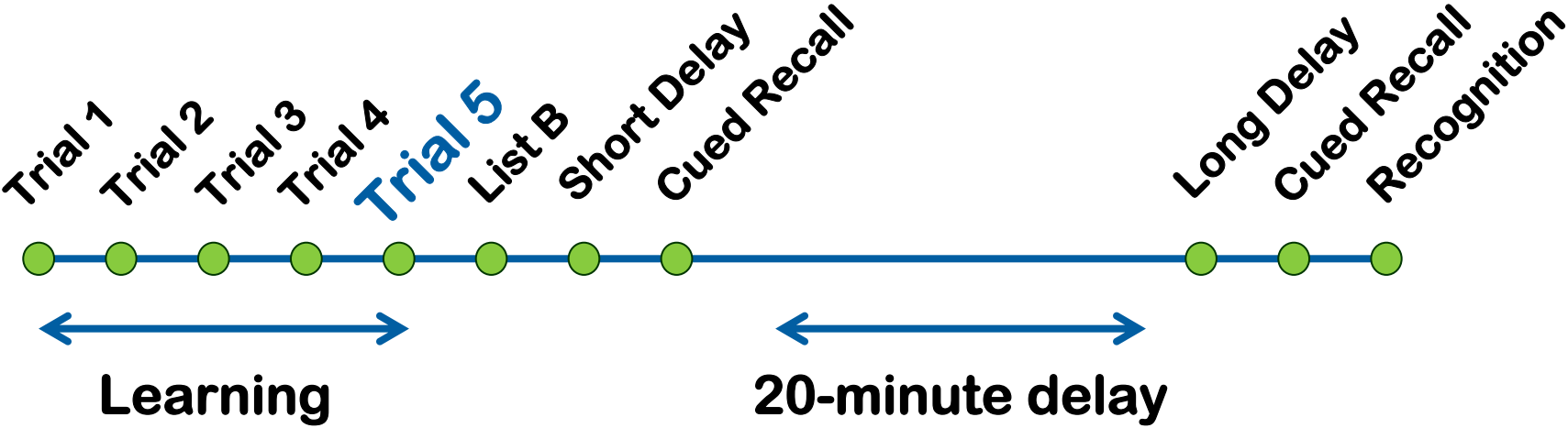
White, Nortz, Mandernach, Huntington, & Steiner, 2002

Strategic Processing

Flexibly making & altering plans to perform efficiently



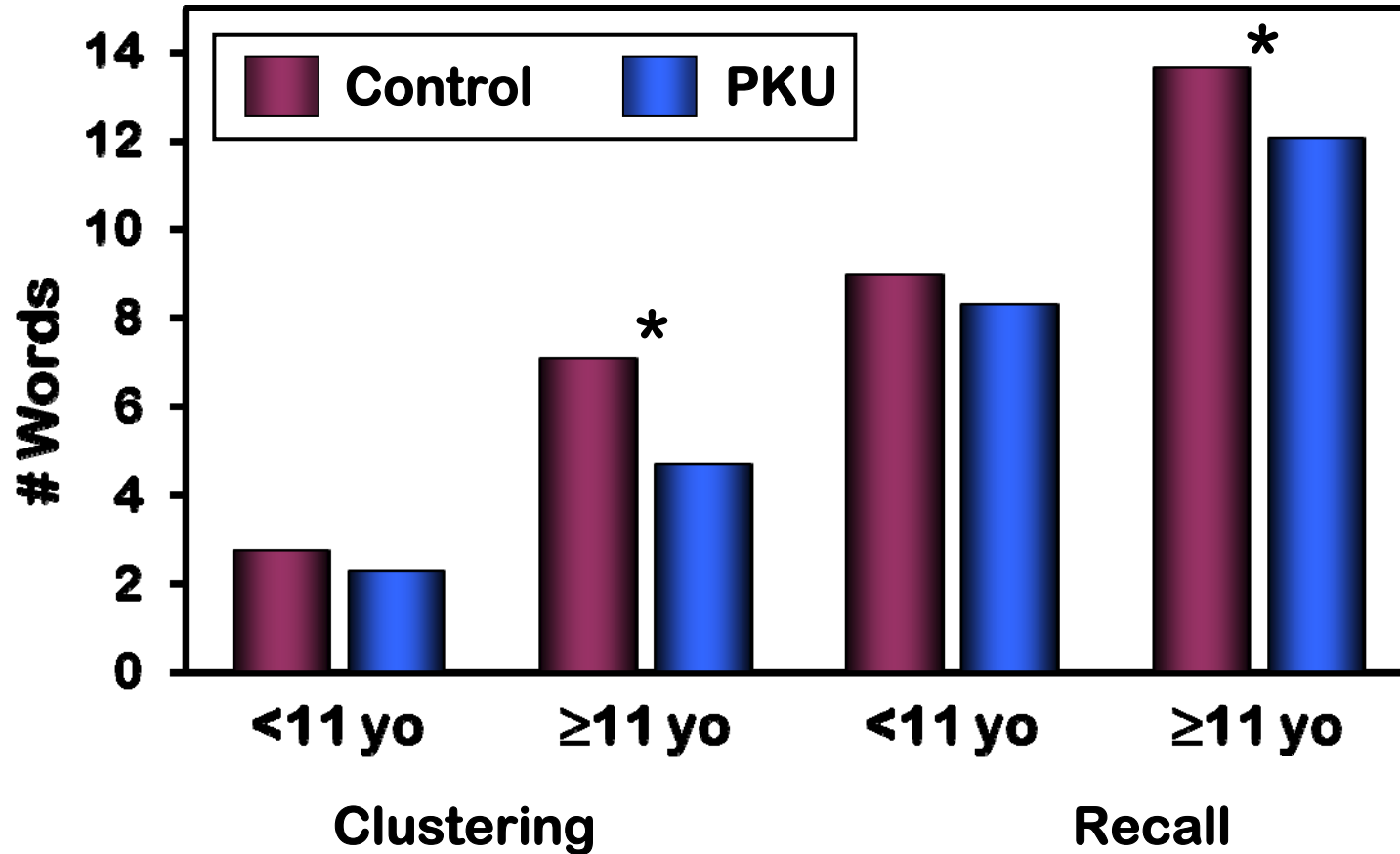
Strategic Processing: CVLT-C



- | | |
|--------------|----------|
| bananas | balloons |
| jacket | belt |
| watermelon | puzzle |
| crayons | blocks |
| strawberries | peaches |
| sweater | hat |
| grapes | marbles |
| shorts | |

- TRIAL 5 RECALL**
- belt
 - hat
 - crayons
 - shorts
 - grapes
 - bananas
 - peaches
- Recall Score = 7
Cluster Score =

Strategic Processing: CVLT-C Trial 5



Importance of Executive Abilities

**Executive abilities affect
all aspects of daily living**

- **Academic achievement**
- **Occupational attainment**
- **Social interaction**
- **Dietary & medical management**

Recommendation



Screening for Difficulties

- **Executive Function**

- **BRIEF-P**
 - **BRIEF**
 - **BRIEF-A**
- } **Behavior Rating Inventory of Executive Function**

- **Social-Emotional Function**

- **BASC-II** **Behavior Assessment System for Children - II**
- **BAI** **Beck Anxiety Inventory**
- **BDI-II** **Beck Depression Inventory - II**

Recommendations for Evaluation

- **School evaluation for special services for children with learning differences**
- **Neuropsychological evaluation for in depth assessment of specific areas of cognition**
- **Psychological evaluation & counseling for social & behavioral difficulties**
- **Psychiatric evaluation for medication if warranted for ADHD or depression**

Recommendations for School

- **Structured school environment**
- **Small class with one-on-one instruction**
- **Arrange environment to enhance attention**
- **Extra time to complete assignments & tests**
- **Divide work into small, manageable units**
- **Written instructions for reference at any time**
- **Time to repeatedly review material**
- **Present material for study in multiple modalities**

Recommendations for Home

- **Maintain regular routine**
- **Keep calendar of daily activities**
- **Choose specific locations for important items (calendar, backpack, car keys)**
- **Remind to “stop, look, & think” before beginning tasks**
- **Alert to key points in conversation & before transitions between activities**

Recommendations for Home

- **Instruct through brief, one-step statements rather than lengthy, complicated directives**
- **Monitor performance as multiple steps of tasks are completed**
- **Assist in determining the most organized approach before beginning a task**
- **Suggest cues and meaningful organizers**
- **Generate checklists for organization**
- **Remind to complete one task before moving to another**

Recommendations for Home

- **Encourage & provide opportunities for independent completion of tasks**
- **Avoid punitive consequences when tasks are not completed independently**
- **Provide praise & concrete rewards for perseverance & completion of tasks**
- **Use time out & restriction of privileges effectively (choose your battles carefully)**

Discussion

