IMPLICIT LEARNING OF SEQUENTIAL REGULARITIES AND SPATIAL CONTEXTS IN CORTICOBASAL SYNDROME PATIENTS

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Abstract

Objective: To investigate implicit learning systems in patients diagnosed with the corticobasal syndrome (CBS), and to determine whether some forms of implicit learning are impaired, while others remain relatively preserved, when CBS patients are compared to healthy controls. To date, no studies of implicit learning in CBS have been reported.

Methods: We recruited five CBS patients enrolled in the Mayo Alzheimer's Disease Research Center (ADRC) and 5 healthy age- and gender-matched controls. Participants completed two different paradigms of implicit learning contextual cueing and sequence learning. In the former, people were asked to locate and identify a target item presented among a display of distractors. In the latter, predictable events alternated with random, unpredictable ones in an Alternating Serial Reaction Time (ASRT) task. Learning on the contextual cueing task relies on the medial temporal lobe system, whereas the ASRT task involves fronto-striatal-cerebellar circuits.

Results: For each task, the difference in performance between frequently occurring and infrequently occurring events (trial type effect) was analyzed on the response time and accuracy measures. The data were submitted to a 2 (Group) x 2 (Trial Type) x 5 (epoch) mixed design ANOVA with repeated measures on the epoch and trial type factors. Results revealed reduced learning effects in CBS patients compared to controls on the ASRT, but not contextual cueing, task. Explicit measures (post-experimental interview and recognition tests) revealed learning was implicit and had occurred without awareness of the regularity.

Conclusions: CBS patients have impairments in implicit learning, particularly in learning of sequential regularities, which rely on the integrity of fronto-striatal circuits. These findings provide further support for the fronto-striatal dysfunction and relative integrity of the medial temporal lobe in CBS.

Method

Participants:

- **5 CBS patients**
  – mean age: 67.2 (*SD*: 3.3); mean education level: 13.6 (*SD*: 2.3)

- **5 healthy controls**
  – mean age: 70.6 (*SD*: 3.9); mean education level: 14.2 (*SD*: 1.1)
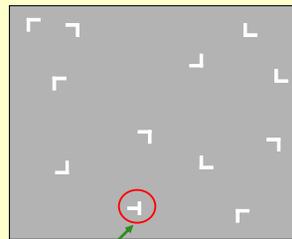
Tasks:

- Contextual Cueing & Alternating Serial Reaction Time (ASRT)

- Recognition tests at the end of each task

Measures of Learning:

- **Implicit:** Difference in performance between predictable and unpredictable trials *(trial-type effect).*

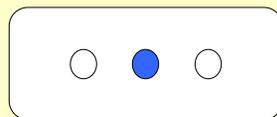- **Explicit**: Verbal reports and Recognition tests.

Contextual Cueing Task

Respond Left

- ❖ Visual array of 12 items
  - 11 distractors (L's--orientation varies)
  - 1 target **(horizontal T)**

- ❖ 1 block = 24 trials
  - 12 **repeated** configurations
  - 12 **novel** configurations

- ❖ On repeated trials
  - Configuration predicts **location** of T
 - NOT direction of T

- ❖ 10 blocks; 5 epochs (2 blocks/epoch)

ASRT Task

- ❖ Three spatially arranged locations

- ❖ On each trial, one of the circles fills in.

- ❖ Pattern trials alternate with random trials
  - *e.g., 1-r-2-r-3-r*

- ❖ 1 block = 70 trials (6-item sequence repeated 10 times; 10 random warm-up trials)

- ❖ 20 blocks; 4 epochs (5 blocks/epoch)

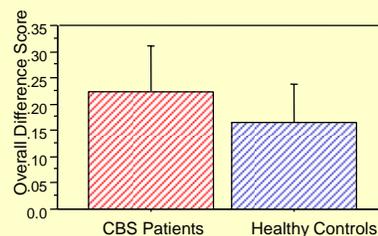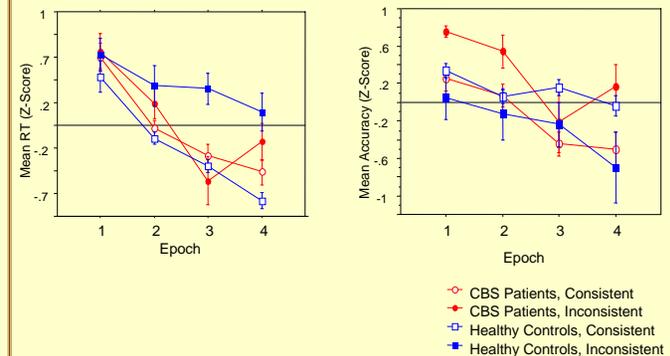## Results #1: CBS Patients were Slower Overall on Both Tasks

Contextual Cueing
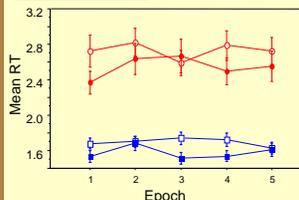
ASRT
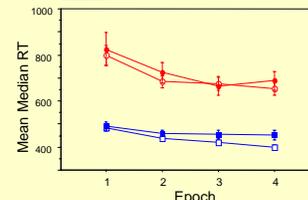
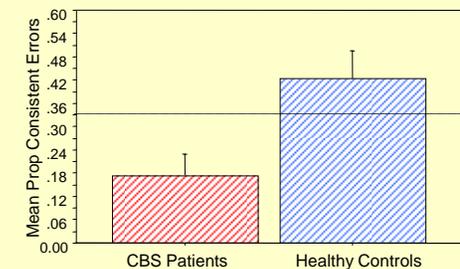## Results #2: Contextual Learning was Preserved in CBS Patients

Results #3: *Sequence Learning was Impaired in CBS Patients*

Trial Type Effects

- CBS Patients, Consistent
- CBS Patients, Inconsistent
- Healthy Controls, Consistent
- Healthy Controls, Inconsistent

Learning-Based Errors

Conclusions

- ♦ Implicit learning of contextual cues was relatively preserved in CBS patients compared to healthy controls, whereas learning of sequential regularities revealed deficits.

  - ➢ *These findings provide further support for the fronto-striatal dysfunction and relative integrity of the medial temporal lobe system in CBS.*

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