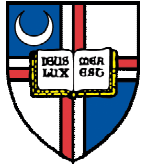




# AGE RELATED TIME OF DAY EFFECTS ON HIGHER ORDER IMPLICIT SEQUENCE LEARNING AND CONTEXTUAL CUEING



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## Abstract

Older adults show substantial time of day effects on many cognitive tasks, performing better in the morning than in the afternoon, whereas younger adults show smaller effects and in the reverse direction. So far, most evidence of such effects in aging has involved explicit learning and memory. For the present study, we examined time of day and aging effects on two tests of implicit learning by reanalyzing data we had collected in an earlier study. One test was an alternating serial response time task (ASRT) in which people responded to a series of stimulus locations containing a subtle, complex structure. The other task was contextual cueing in which participants search for a target among distractors. The former involves fronto-striatal-cerebellar circuits and the latter, the medial temporal lobe system. For both tasks, pattern learning was inferred from faster and/or more accurate responding to predictable than unpredictable stimuli. We compared 18 young (5 AM, 13 PM) and 18 old subjects (9 AM, 9 PM) on ASRT, and the same 18 young (5 AM, 13 PM) and 18 old (9 AM, 9 PM) on contextual cueing. On the ASRT task, we found time of day effects on pattern learning in the predicted direction for the older group only. On contextual cueing, neither age group revealed time of day effects. The results indicate that time of day effects extend to some forms of implicit learning. The findings have implications for neuro-cognitive theories of aging, and for rehabilitation and training programs.

## Questions

- Is implicit learning enhanced at different times of day for elderly versus young people?
- Does time of day affect implicit learning of higher order sequential patterns?
- Does time of day affect implicit learning of contextual information?

## Participants

- 18 young (18-22 years)(AM; PM) Mean age: 21; 20  
Mean education level: 14.8; 14.2 Mean self-rated health: 4.6; 4.8
- 18 elderly (65 years and above)(AM; PM) Mean age: 71.6; 69.9  
Mean education level: 17.2; 16.8 Mean self-rated health: 4.3; 4.1

## Method

### Procedure:

#### Day 1:

- Contextual cueing task
- Time of day classification:  
AM: 5 young, 9 elderly; PM: 13 young, 9 elderly

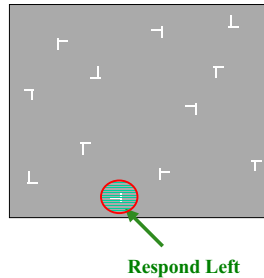
#### Day 2:

- Alternating SRT (ASRT) task
- Time of day classification:  
AM: 5 young, 9 elderly; PM: 13 young, 9 elderly

### Measure of Learning:

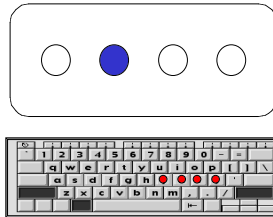
Difference in performance between predictable and unpredictable trials (trial-type effect).

## Contextual Cueing Task



- 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
- 30 blocks (1 epoch = 5 blocks)

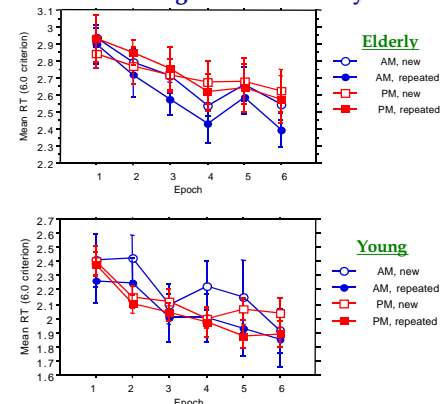
## Alternating Serial Reaction Time (ASRT) Task



- Spatially arranged locations
- On each trial, one of the circles fills in
- Pattern trials alternate with random trials
  - Sample pattern: **1 r 2 r 4 r 3 r**
  - where **r** stands for random trials
- 1 block = 80 trials (10 repetitions of pattern)
- 2 sessions; 20 blocks per session
- 8 epochs; 1 epoch = 5 blocks

## Results #1

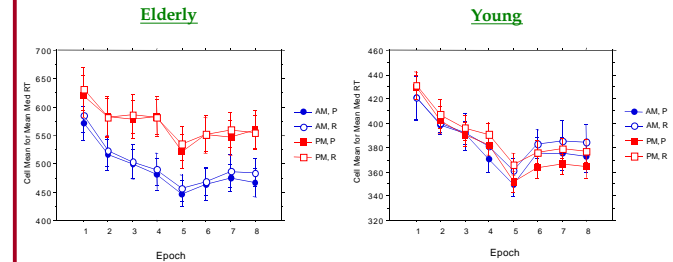
### Contextual Cueing: No Time of Day Effects



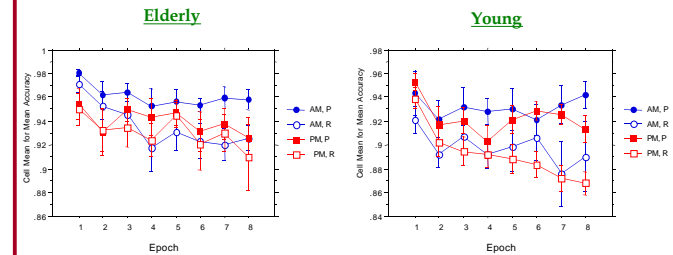
## Results #2

### ASRT: Time of Day Effects for Elderly but not Young

#### Response Time



#### Accuracy



## Conclusions

- No time of day effects for young on either implicit sequence learning or contextual cueing
- Time of day effects for elderly for implicit sequence learning, but not contextual cueing
- Elders' sequence learning is better in the morning than afternoon
- Consistent with different cognitive/neural systems underlying these two kinds of implicit learning
- Implications for maximizing learning and rehabilitation

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