



# LONG-TERM RETENTION OF REGULARITIES IN AN ALTERNATING SERIAL REACTION TIME TASK

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## Background

Individuals show implicit learning of both simple repeating (Nissen & Bullemer, 1987) and subtle probabilistic regularities (Howard & Howard, 1997) in the serial reaction time (SRT) task. Although there is evidence that implicit knowledge is remembered over very long intervals in some tasks (Davis et al., 2001; Mitchell, 2006; Reber, 1993), little is known about the retention of implicitly acquired skill in the SRT task. One previous study reported two-week retention of simple repeating patterns in Alzheimer's patients and age-matched healthy controls (Knopman, 1991). We have found two-month retention of subtle sequence regularities in a four-element Alternating SRT task in middle-aged adults (Feeny, 2000) as well as three-year retention of subtle sequence regularities in a three-element Alternating SRT task in older adults (Romano et al., 2006). However, a study of young adults reported no retention of simple repeating patterns after one year (Willingham & Dumas, 1997). The present study examined long-term retention of implicit knowledge of higher-order probabilistic regularities in young adults.

## Procedure

- 4-element ASRT task
  - Pattern trials alternate with Random trials (e.g. 1r2r3r4r...)
  - 8 epochs at **Time 1** and **Time 2** (1 month or 1 year later)
  - 1 epoch = 20 blocks of 80 trials (8-item sequence repeated 10 times)
  - **Measures of Learning:**
    - **Implicit:** Trial-Type Effect (Difference between Pattern and Random trials)
    - **Explicit:** Recognition test; Card-Sorting; Interview
  - **Measures of Retention:**
    - <sup>1,2,3,4</sup>**Epoch 1 vs. Epoch 9:** "Exposure Effects" (Knopman, 1991)
      - If there is retention, these Trial Type Effects should be different.
    - <sup>1,4</sup>**Epoch 8 vs. Epoch 16**
      - If there is retention, the Trial Type Effect at epoch 16 should be greater.
    - <sup>1,2,3,4</sup>**Average of Epoch 1-8 vs. Average of Epoch 9-16**
      - If there is retention, the average Trial Type Effect at Time 2 (epochs 9-16) should be greater than the Trial Type Effect at Time 1 (epochs 1-8).
    - <sup>1,2,3,4</sup>**Epoch 2 vs. Epoch 10**
      - If there is retention, the Trial Type Effect at epoch 10 should be greater.
    - <sup>3</sup>**Epoch 8 vs. Epoch 9:** "Retention" (Knopman, 1991)
      - If there is perfect retention, these Trial Type Effects should NOT be different.
- <sup>1</sup>Indicates significant effects for accuracy at 1 month post. <sup>2</sup>Indicates significant effects for RT at 1 month post. <sup>3</sup>Indicates significant effects for accuracy at 1 year post. <sup>4</sup>Indicates significant effects for RT at 1 year post.

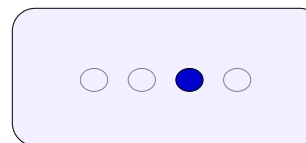
## Interpretations and Conclusions

Participants quickly relearned the probabilistic regularity they had learned earlier and/or showed retention of the trial type effect after both intervals. Following one month, individuals started off responding more quickly and with the same level of sequence learning as they had acquired one month earlier. They continued to learn (the trial type effect got larger over time), ending with greater learning than they had shown one month earlier. Following one year, individuals started off responding at the same speed as they had a year before. They continued to learn (the trial type effect got larger over time) and improve reaction time, ending with greater learning and faster reaction time than they had demonstrated one year earlier. Therefore, both groups revealed the retention of implicit sequence-specific knowledge following an extended period of time. This study supports the notion that implicitly acquired sequence-specific information is in fact retained for at least a year.

## References

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## Alternating Serial Reaction Time Task



Response

Pattern trials alternate with Random trials

Example sequences:

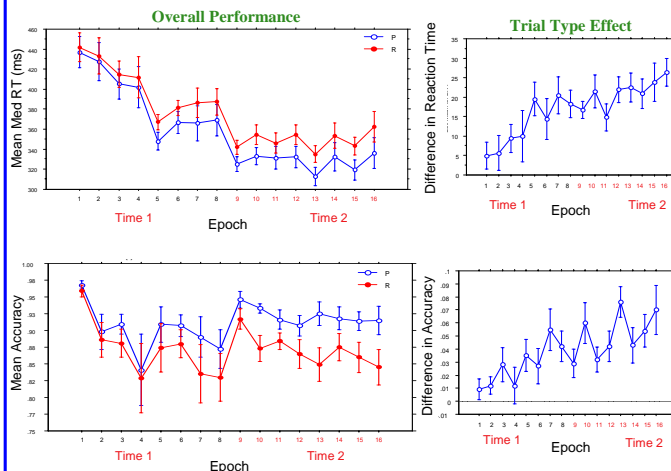
1r2r3r4r...

1r3r4r2r...

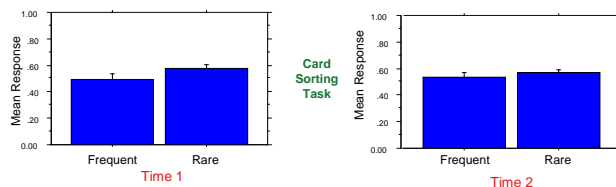
1r4r3r2r...

## 1 Month Retention Results

### Implicit Learning



### Explicit Recognition



### Participants

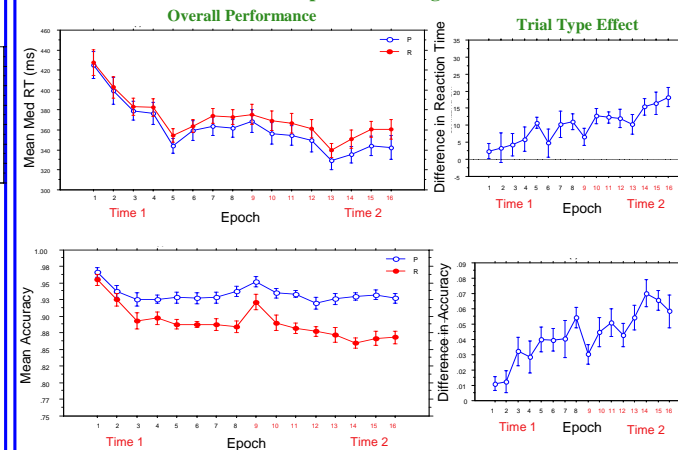
Gender	7F / 3M
Age (in years)	18.11 (18-20)
Education (in years)	12.50 (12-15)
Self-Rated Health*	4.30 (3-5)
WAIS-III Vocabulary	32.60 (24-47)

\*Responses ranged from 1 (poor) to 5 (excellent). Means (and ranges) at Time 2 reported.

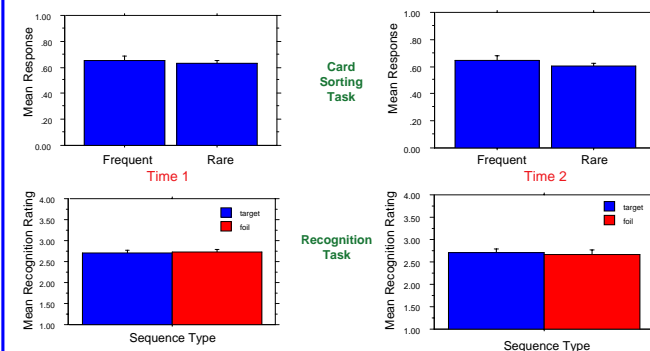
- Young adults retain knowledge of subtle sequential regularities for at least 1 month!
- There was greater Trial Type Effect at **Time 2** compared to **Time 1**.
- Participants retain and relearn the regularity quickly at **Time 2** (1 month later).
- Participants cannot differentiate Frequent and Rare sequences explicitly.
- Learning is implicit at both **Time 1** and **Time 2**.

## 1 Year Retention Results

### Implicit Learning



### Explicit Recognition



### Participants

Gender	5F / 8M
Age (in years)	20.74 (19-23)
Education (in years)	13.90 (13-16)
Self-Rated Health*	4.38 (3-5)
WAIS-III Vocabulary	36.31 (26-50)

\*Responses ranged from 1 (poor) to 5 (excellent). Means (and ranges) at Time 2 reported.

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