

IMPLICIT LEARNING OF HIGHER ORDER AUDITORY SEQUENCES WITH RESPONSE REMAPPING IN YOUNG AND ELDERLY ADULTS



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Goal

To assess age differences in implicit learning of higher order non-spatial auditory sequences in the absence of spatio-motor response sequencing.

Abstract

The Serial Reaction Time (SRT) task has been used to investigate implicit learning and aging of both visual and auditory sequences. While both age groups demonstrate learning, deficits occur in the magnitude of learning for complex sequences (e.g., Dennis, Howard, & Howard, in press). Theories of sequence learning suggest that people may learn contingencies among perceptual stimuli, responses, or a combination thereof. However, because previous research has employed a one-to-one stimulus-to-response mapping, it is unclear what role motor sequencing plays in learning or age-related deficits. The present study examines implicit sequence learning and aging when the stimulus-to-response mapping changes on every trial. This technique was introduced by Goschke (2001) to investigate sequence learning in the absence of motor sequencing. Previous research has found age constancy in learning of first order sequences (Dennis, Howard, & Howard, 2002). However, the young adults gained explicit knowledge of the simple sequence structure, contaminating implicit learning measures. The current study examines a more purely implicit process by investigating sequence learning of more complex, lag 2 sequences (e.g., 1r2r3r4r, where r denotes a randomly selected event). Results indicate that both young and elderly adults show evidence of sequence learning under constant response mapping conditions, but demonstrate deficits with random response mapping. This suggests that the random response mapping interferes with either learning or performance on higher-order sequences.

Participants

Constant Mapping

Random Mapping

	Young	Elderly	Young*	Elderly
Age	21.31 (1.16)	74.89 (5.33)	19.83 (1.09)	72.64 (7.37)
Education	14.75 (1.04)	16.38 (3.20)	12.75 (1.49)	17.86 (2.73)
Vocabulary	9.882 (5.67)	30.63 (5.21)	31.00 (5.29)	34.75 (6.71)
Digit Coding	93.25 (10.77)	69.75 (16.46)	84.67 (26.16)	58.63 (11.77)

* Represents data for 3 of 8 young only

Method

•**Participants:** 8 young and 8 elderly in each condition (Constant response mapping / Random response mapping)

•**Sequence structure:** each participant received one of two different lag 2 sequences:

- Sequence 1: 1r2r3r
- Sequence 2: 1r3r2r

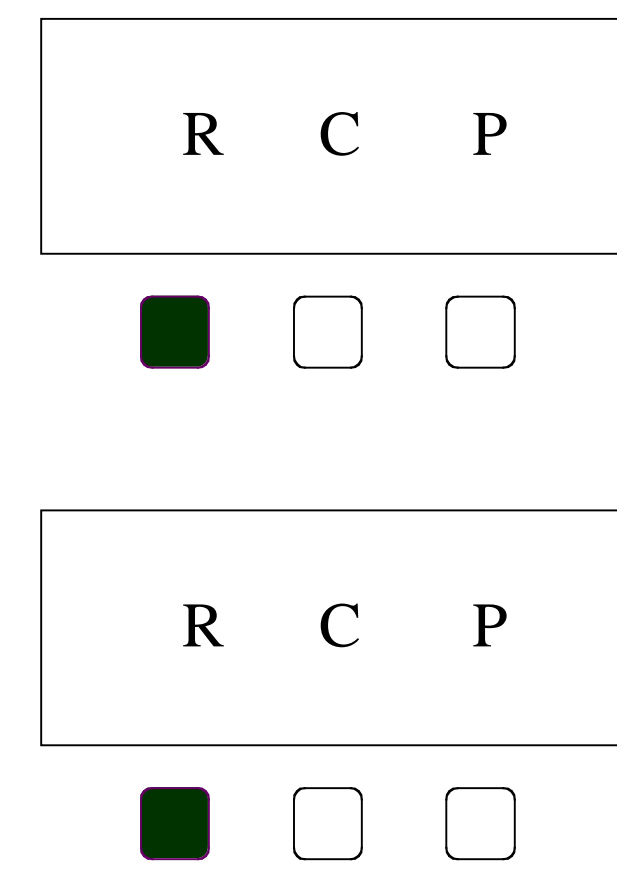
•**Practice:** 1 block of 30 structured trials

•**Task:** 40 structured blocks (60 trials each) over 2 days

•**Explicit assessment:** recognition task & exit interviews

Auditory ASRT Task with Response Remapping

Constant



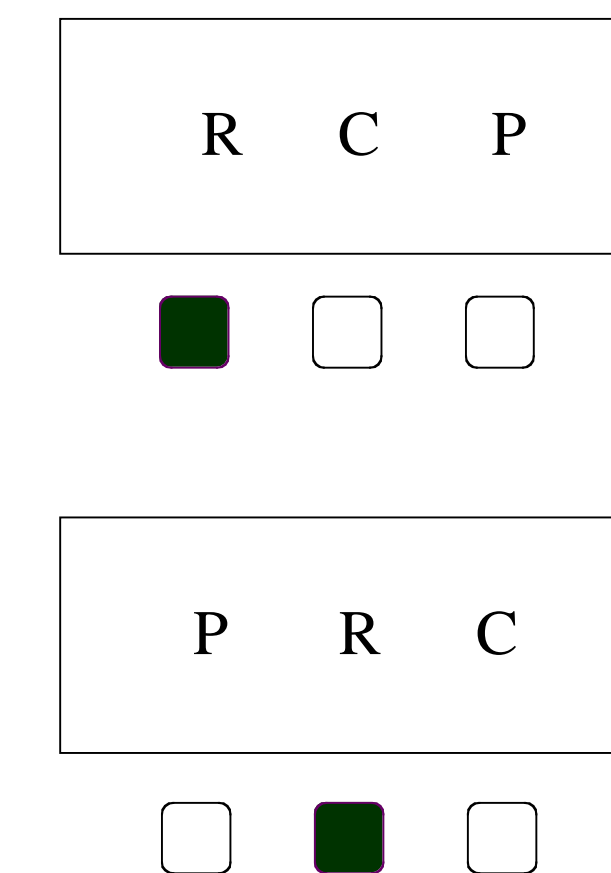
TRIAL 1

“Romantic”

TRIAL 2

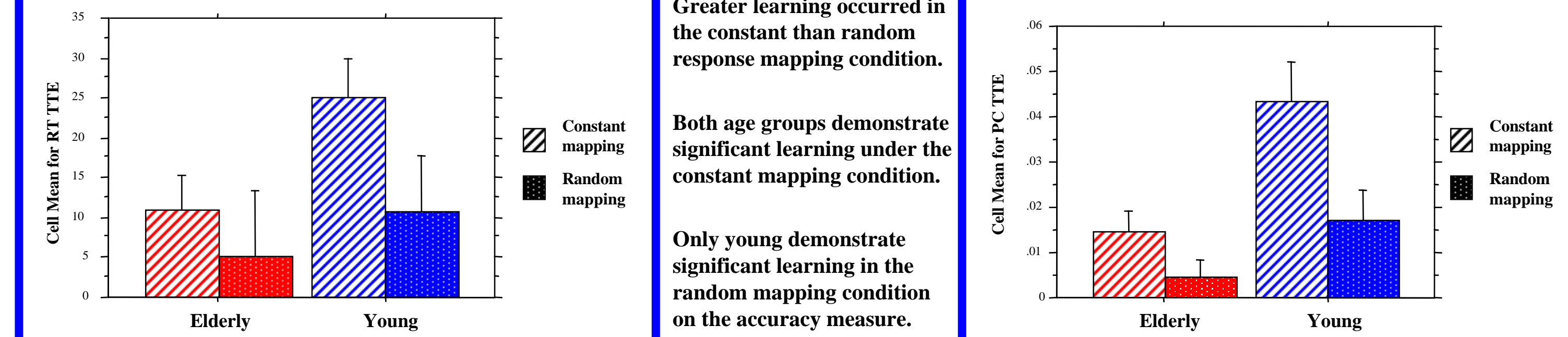
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Random



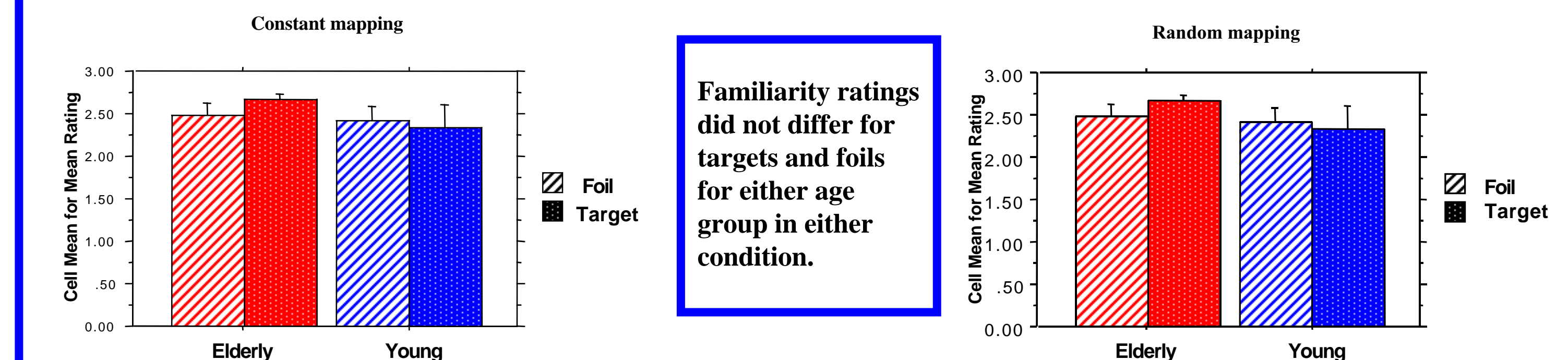
The stimulus-to-response mapping is indicated by a three-letter display presented on the computer screen. The letters correspond to the three stimulus words. In the constant response mapping condition the arrangement of letters on the screen remains fixed on every trial. In the random response mapping condition the arrangement of letters is randomly determined on each trial, thereby creating a response sequence that is spatially random. Hence, in the random mapping condition, learning cannot be based on spatio-motor response sequencing.

Are there performance differences across response mapping conditions?



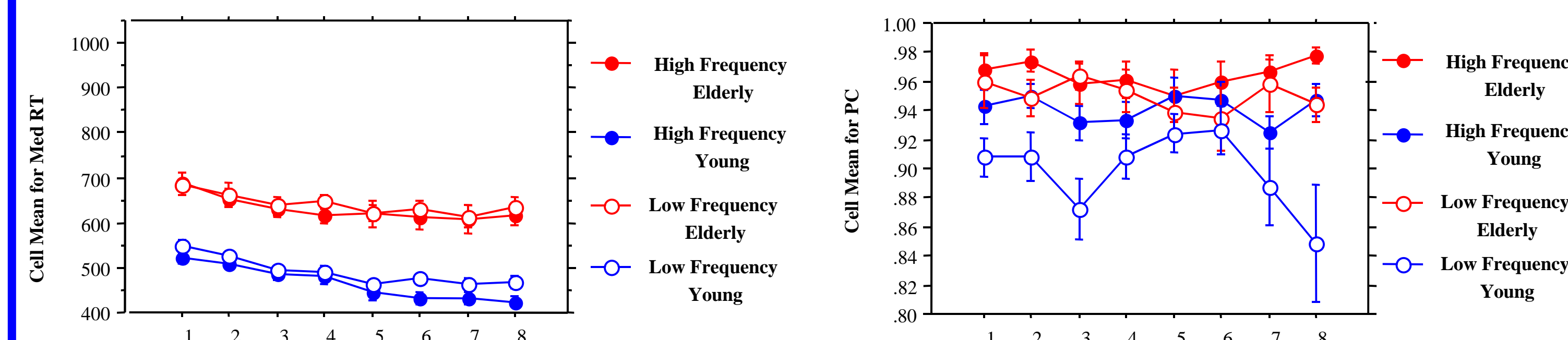
Greater learning occurred in the constant than random response mapping condition. Both age groups demonstrate significant learning under the constant mapping condition. Only young demonstrate significant learning in the random mapping condition on the accuracy measure.

Age differences in recognition?



Familiarity ratings did not differ for targets and foils for either age group in either condition.

Are there age differences in the constant response mapping condition?

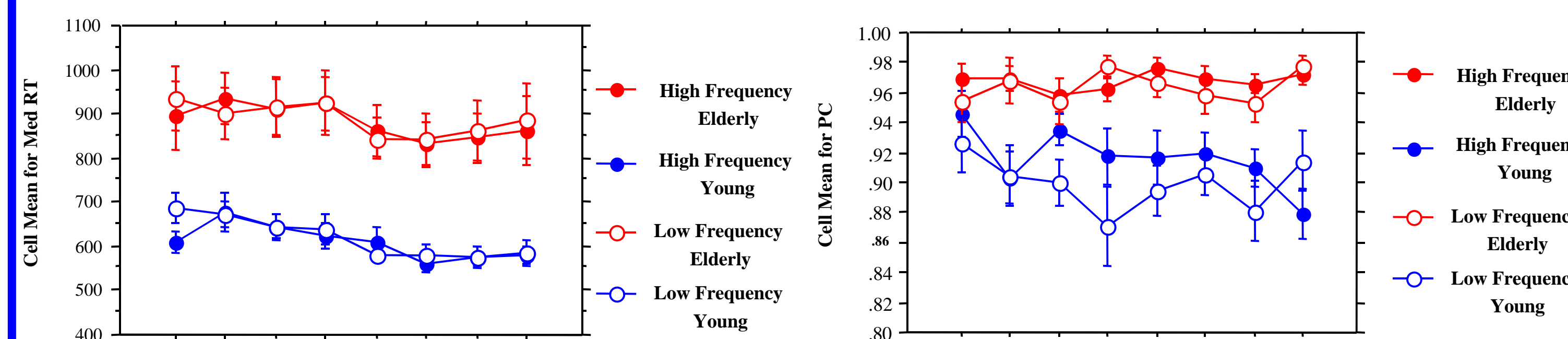


Both young and elderly demonstrate significant sequence knowledge on the RT measure. Although overall RTs differ, sequence learning does not differ significantly between groups.

Both groups show learning on the accuracy measure, but elderly demonstrate significantly less sequence learning than young.

These results are consistent with previous findings with lag 2 sequences. Both age groups show sequence learning, but elderly show less learning than young.

Are there age differences in the random response mapping condition?



Neither group shows evidence of sequence learning on RT under the random mapping condition.

The young show evidence of sequence learning on the accuracy measure, whereas the elderly do not.

Only young demonstrate significant sequence knowledge as assessed by both the RT & PC measures.

These results suggest that with random response mapping sequence learning is suppressed in elderly adults.

Conclusions

- Both young and elderly exhibit sequence knowledge under the constant response mapping condition. However, elderly exhibit an age deficit compared to young.
- There is some evidence that young are able to learn a lag 2 sequence in the absence of spatio-motor sequencing, but the elderly can not.
- Evidence of learning in young adults under the random response mapping condition suggests that motor sequencing is not essential for learning.
- Neither group shows evidence of explicit knowledge on the recognition test or end-of-session questionnaires in either condition.

References

Dennis, N. A., Howard, J. H., Jr., & Howard, D. V. (in press). Age-related deficits in learning sequences of spoken words. *Journal of Gerontology B: Psychological Sciences*.

Dennis, N. A., Howard, J. H., Jr., & Howard, D. V. (2002). Implicit sequence learning with response remapping in young and elderly adults. Poster presented at the 32nd Annual Society For Neuroscience Conference, Orlando, FL.

Goschke, T., A. D. Friederici, et al. (2001). "Procedural learning in Broca's aphasia: dissociation between the implicit acquisition of spatio-motor and phoneme sequences." *Journal of Cognitive Neuroscience* 13(3): 370-88.

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