

# AGING AND IMPLICIT LEARNING OF A SIMPLE POSITIONAL/SEQUENTIAL REGULARITY

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## Goal

To determine whether implicit learning of a simple positional regularity is spared in normal aging, as would be predicted from earlier work on perceptual/motor sequence learning.

## Background

Although explicit learning declines in normal aging, the extent to which implicit learning does so is unclear. There has been relatively little research on the topic, and isolating implicit from explicit learning has been difficult. Findings from cognitive neuroscience suggest that there are several implicit learning systems subserved by distinct neural circuits, which decline differently with age (e.g., Prull, Gabrieli, & Bunge, 2000). In addition, behavioral evidence from studies of perceptual/motor sequence learning suggests that age deficits in implicit learning occur when the regularity to be learned is structurally complex, hence calling on greater processing demands, but not when the regularity is simple (e.g., Curran, 1997; Howard & Howard, 1997).

Here we use a novel task developed by Frick & Lee (1995) to examine the implicit learning of a simple positional regularity, i.e., that the same letter always occurred in the second position of studied lists. In the Frick & Lee study, young adults first attempted to recall letter strings, each of which contained the regularity (study phase). Later (discrimination phase), they were able to discriminate strings containing this regularity from those that didn't, even though they were unable to report the nature of the regularity.

## Methods

**Study Phase.** Participants were told that the experiment was a test of immediate memory. They were shown one seven-letter-long string at a time on a computer screen and were asked to recall it immediately following its disappearance. There were 24 trials in this phase.

**Discrimination Phase.** This occurred immediately after the study phase. On each of 20 discrimination trials, people were shown two seven-item-long letter strings, side-by-side on the computer screen. They were asked to choose the letter string "which looks more familiar".

**Assessment of declarative knowledge.** Participants were then asked two questions.

(1) "Can you describe any particular reason for choosing one of the letter strings over the other? If so, please explain that reason. Even if you are unsure, please make a guess."

(2) You may have noticed that there was a pattern among all of the string sets which you were asked to recall. Do you have any idea what the pattern was? Even if you are unsure, please make a guess."

## Letter Strings

### Study Phase

"Recall each string. . ."

**XHCRJVZ**

**THYVXCN**

A total of 24 letter strings, each 7 consonants long and with no consonants repeating within a string, were created. The strings were the same for all participants, with the exception of the critical second letter. Each of the following 6 critical letters was used for 2 participants of each age: H, K, M, W, F, & D. This same critical letter occurred as the second letter in all 24 strings for a given person. For example, the strings above are the first two seen by a participant whose critical letter was H.

### Discrimination Phase

"Choose the letter string that looks more familiar. . ."

**QHBVCNX**

**CNQVXBH**

Neither of the strings in a discrimination pair had been seen previously. Both strings contained the same letters but in different positions. In one of the strings, but not the other, the critical letter was in the second position, and so conformed to the regularity encountered during the learning phase.

NOTE: All letters actually appeared in black.

## Participants

Group	Young	Old
Male	4	8
Female	8	4
Age (years)	20.9 ± 1.68	73.25 ± 4.43**
Education	14.67 ± 1.56	17.4 ± 2.67**
Health (self-rated) <sup>1</sup>	4.55 ± 0.52	4.25 ± 0.62
WAIS-R Vocabulary	34.17 ± 8.49	37.17 ± 6.12
WAIS-R Digit Symbol (copying)	130.17 ± 7.26	108.42 ± 17.93**
WAIS-R Digit Symbol (coding)	91.75 ± 7.58	63.42 ± 17.61**
Digit Span	21.58 ± 3.94	20.0 ± 4.06
Letter & Number Sequencing	12.08 ± 2.64	11.5 ± 2.15
Logical Memory I Total Recall	37.75 ± 8.46	42.58 ± 6.87
Logical Memory II Total Recall	26.25 ± 4.71	27.92 ± 4.87
Logical Memory % Retention	95.48 ± 6.93	88.41 ± 9.64**
Mini-Mental	29.33 ± 0.98	28.5 ± 2.32

(mean and standard deviations)

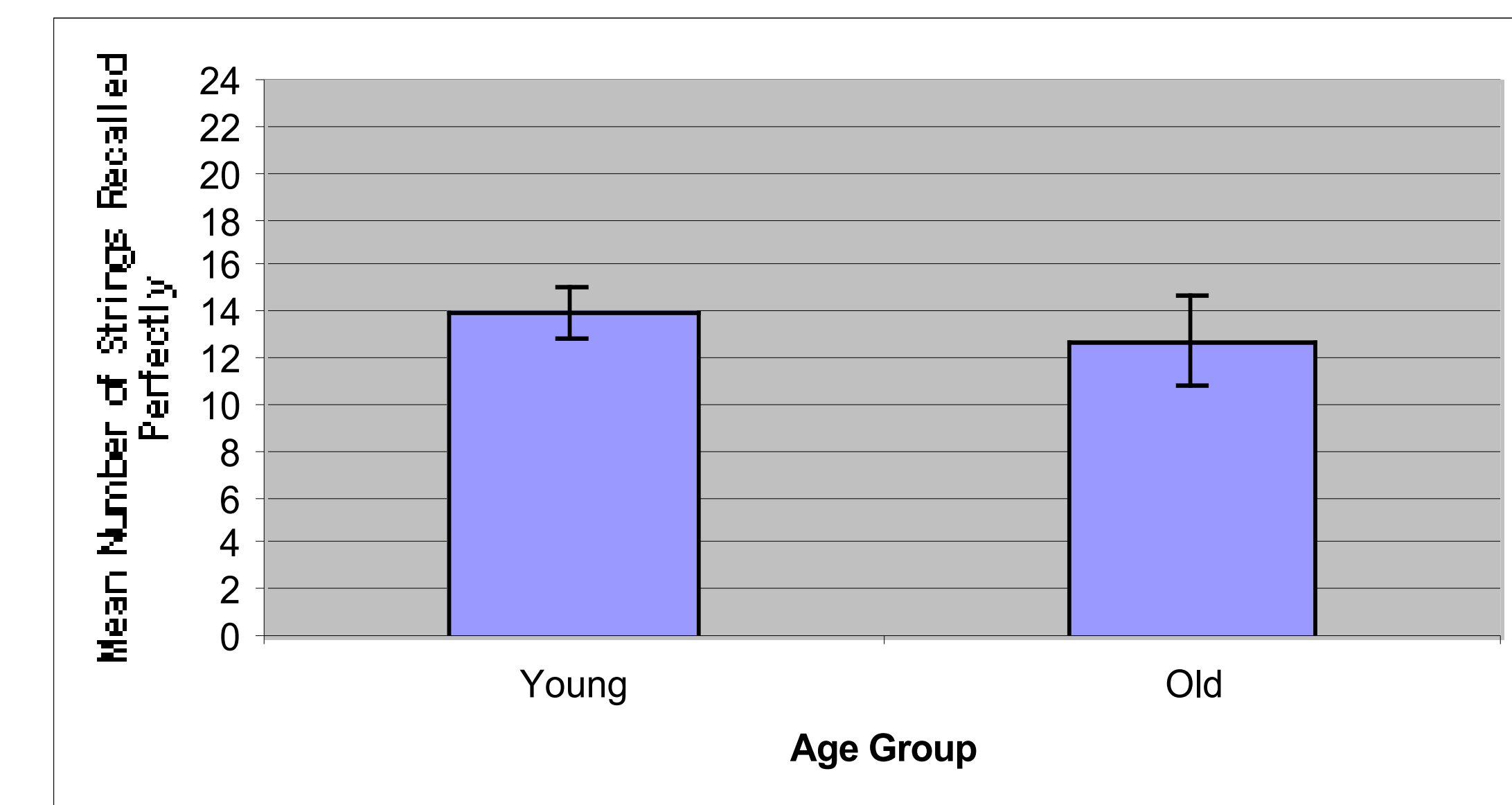
\*\*Age Groups Differ Significantly,  $p < .05$

<sup>1</sup>Responses range from 1 (poor) to 5 (excellent)

## Results

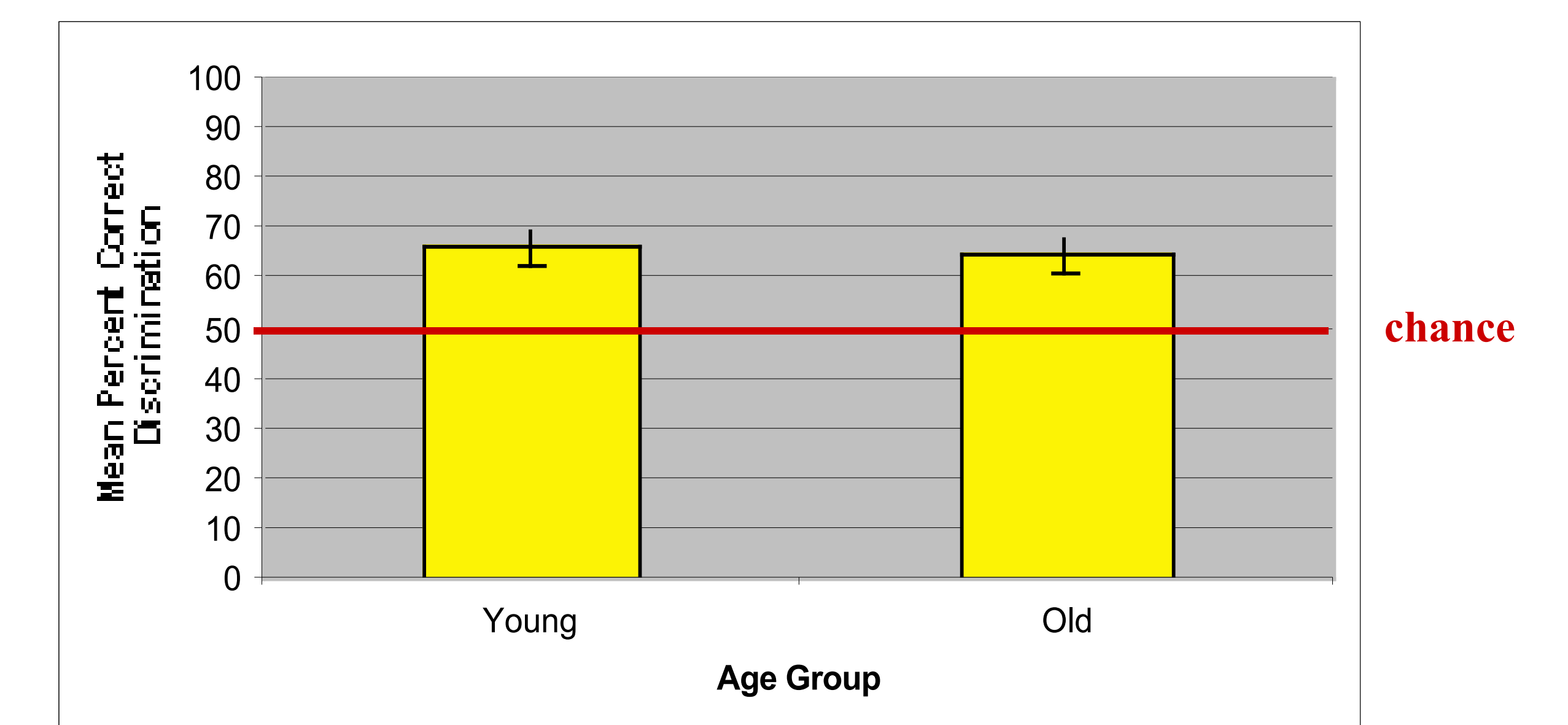
### Study Phase

Both ages recalled the strings equally well.



### Discrimination Phase

Both ages were above chance, and equally good, at choosing the pattern-consistent string.



## Conclusions

- People of both age groups were above chance at choosing pattern-consistent strings, indicating they had learned about the regularity
- Old people were as good as young at choosing the pattern-consistent strings, indicating age constancy in learning
- Despite the simple nature of the regularity, no one of either age was able to describe it, thus the learning was implicit
- Therefore, implicit learning of a simple positional regularity does not decline in normal aging.

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