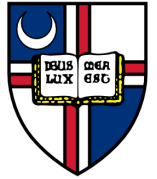




AGE DIFFERENCES IN IMPLICIT PERCEPTUAL ASSOCIATIVE LEARNING OF ARBITRARY SEQUENCES

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BACKGROUND AND PURPOSE

IMPLICIT PROBABILISTIC ASSOCIATIVE LEARNING:

- The acquisition of probabilistic temporal regularities that occurs without intent or explicit knowledge

AGE DEFICITS IN IMPLICIT PROBABILISTIC ASSOCIATIVE LEARNING?

- Remains understudied and findings are inconclusive
- Cannot rule out alternative age-related explanations (e.g., declines in motor movements, explicit knowledge or in ability to learn rule-governed associative sequences)

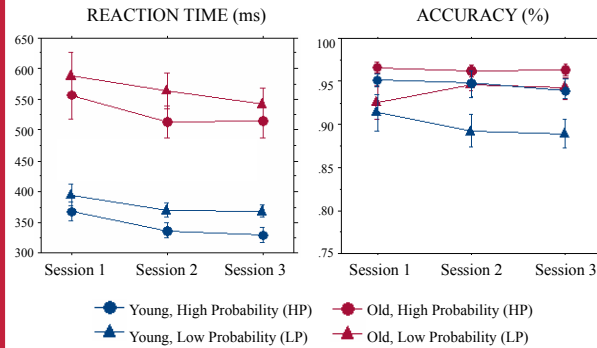
THE TRIPLETS LEARNING TASK: (Howard et al., 2008)

- Implicit probabilistic associative learning task that complements the traditional (Alternating) Serial Reaction Time Tasks (Howard & Howard, 1997; Nissen & Bullemer, 1987)
- No motor sequencing
- No variability in stimulus event timing
- No explicit knowledge
- No restrictions on nature/level of statistical regularity studied

PURPOSE OF PRESENT STUDY?

- Can people learn implicit, non-motor, non-rule based (arbitrary) probabilistic perceptual sequences?
- Are there age-related differences in such learning?

RESULTS: IMPLICIT SEQUENCE LEARNING



REACTION TIME:

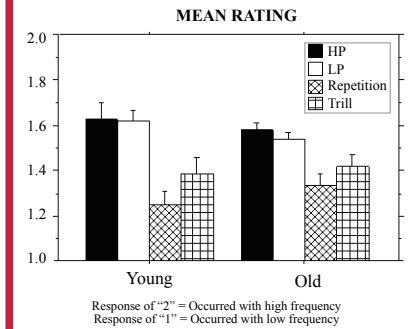
- Faster on HP versus LP ($p < .001$)
- RT decreasing across sessions ($p < .005$)
- Young adults faster overall than old adults ($p < .0001$)

ACCURACY:

- Overall ~ 94%
- More accurate on HP versus LP ($p < .001$)
- Old adults are marginally more accurate than young adults ($p = .06$)

NO EXPLICIT KNOWLEDGE

- No evidence of explicit knowledge about high and low probability triplet frequencies
- Participants did differentiate repetitions and trills, suggesting that they understood the task and were not responding randomly



METHOD

PARTICIPANTS

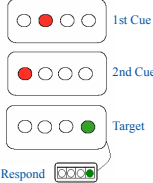
- 15 younger adults
 - Age: $19.9 \pm .9$ years (range: 18-21 years)
 - Gender: 6 male, 9 female
- 15 older adults
 - Age: 71.3 ± 6.0 years (range: 66-87 years)
 - Gender: 5 male, 10 female

TRIPLETS LEARNING TASK

- View stimuli at 1 of 4 locations that fill in red, then green in discrete, three-event sequences or 'triplets'
- Observe red cue events and respond only to the third, green target

- Shortened training from Howard et al. (2008)

- 3 training sessions
- 15 blocks of 50 trials (total)
- Feedback (accuracy and RT) provided after each block



- A randomly chosen set of 16 triplets occurred more frequently than remaining 32 triplets (ratio 9:1)
- No repetitions or trills presented

- Implicit Sequence Learning: Compare the triplets that occurred with High Probability (HP) versus Low Probability (LP)

POST-EXPERIMENTAL RECOGNITION TASK

- Sensitive measure of explicit knowledge
- Judge whether random sampling of triplets occurred more or less frequently during training
- 64 triplets presented, including repetitions and trills

RESULTS: ASSOCIATIVE LEARNING SCORES

ANOVA

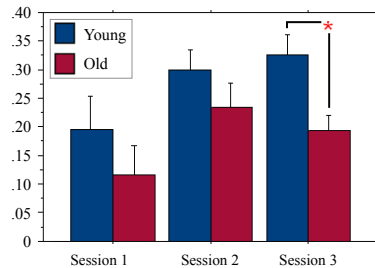
Associative learning increased with practice ($p < .05$)
Young demonstrated greater associative learning than the old ($p < .05$)

POST-HOC SINGLE SAMPLE T-TESTS

Associative learning is greater than 0 in both young and old in all 3 sessions (p 's $< .05$)

POST-HOC UNPAIRED T-TESTS

Associative learning greater in young than old in Session 3 only ($p < .01$)



CALCULATING LEARNING SCORES

- Linear regression for each participant based on the extent to which each triplet's reaction time was predicted by that triplet's frequency of occurrence
- Each regression multiplied by -1 (for ease of interpretation)
- Higher scores reflect greater sequence learning (i.e. triplets occurring with HP would be responded to more quickly) whereas lower scores (e.g., 0) reflect no sequence learning

SUMMARY AND DISCUSSION

AGING AND IMPLICIT LEARNING

- Often claimed to be spared
- Fails to recognize many forms of implicit learning
- Some forms show age deficits

PROBABILISTIC, NON-MOTOR, NON-RULE GOVERNED ASSOCIATIONS

- Learning is implicit
- Both young and old adults demonstrate learning
- Age deficits in the magnitude of learning, especially during later stages of training

ASSOCIATIVE LEARNING SCORES

- Not influenced by RT and variability differences
- Makes direct group comparisons less problematic
- Revealed differences between young and old adults

MECHANISMS UNDERLYING AGE DEFICITS

- Age differences may reflect that different brain systems are involved as training progresses
 - Medial temporal lobe involved in early training vs. striatum in later training
 - Greater age-related structural declines in striatum relative to medial temporal lobe

REDUCED TRAINING

- Present study required only 30 minutes of testing
- Beneficial for imaging studies or patient groups

Cognitive Aging Conference

Atlanta, GA 2010

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Supported by NIH Grant R37AG15450 and a grant to the author from the American Psychological Association